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J. F. KELLY, *Editor*

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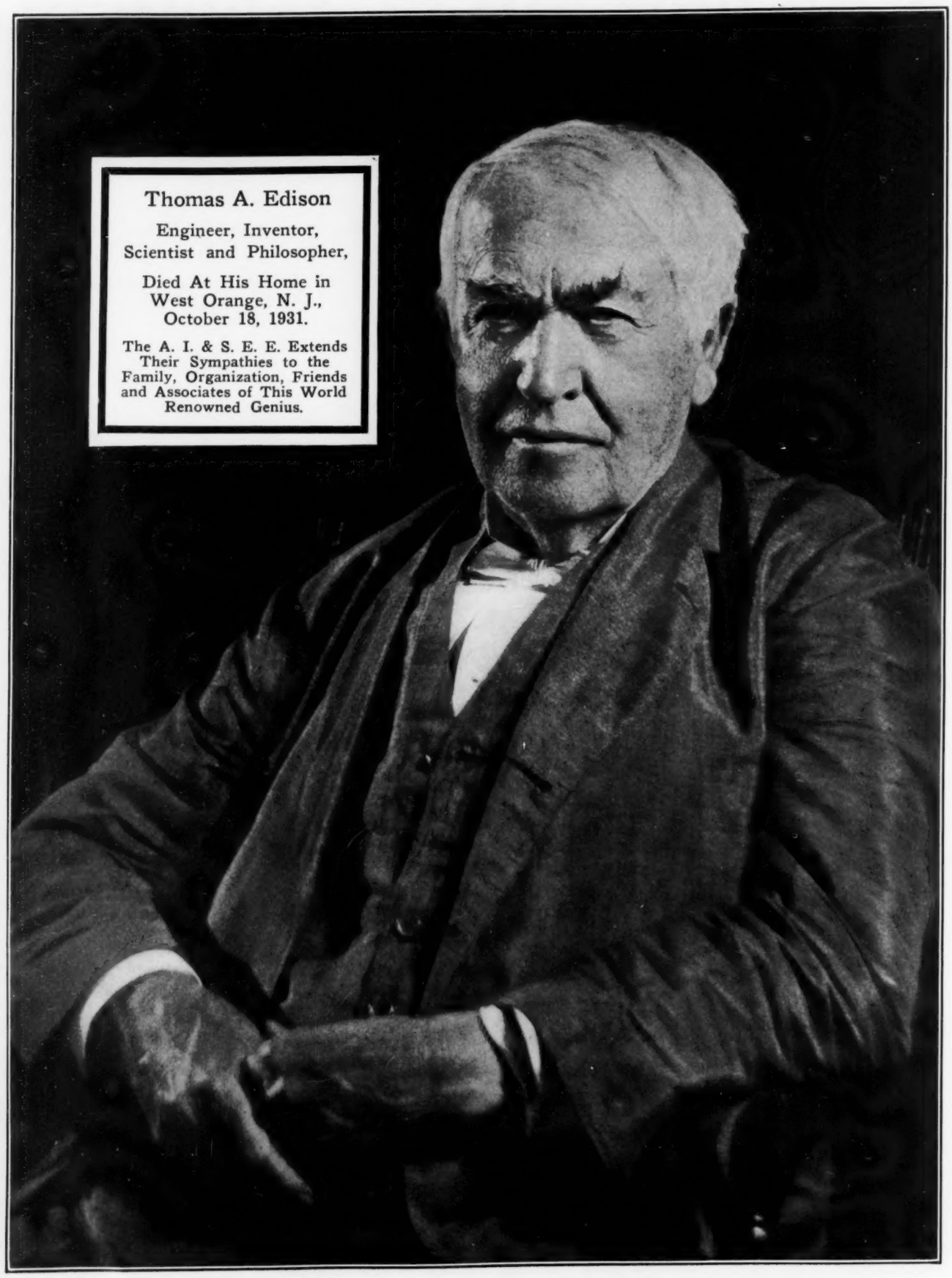
Thomas A. Edison
Engineer, Inventor,
Scientist and Philosopher,
Died At His Home in
West Orange, N. J.,
October 18, 1931.
The A. I. & S. E. E. Extends
Their Sympathies to the
Family, Organization, Friends
and Associates of This World
Renowned Genius.

EDITORIAL

Recent Developments In Sheet Mills

Without any idle boastfulness, the steel industry, as a whole, can point to its record of the past two decades as one of continuous improvement in production methods. Standards of quality have been raised and attained only to be raised still higher. Economies in the process and methods have brought about repeated diminutions in production costs.

These improvements have been so rapid in sequence and so diverse in nature that it would be impossible to outline them within the scope of these columns.

In sheet and tin mill practice, for instance, such radical changes in the handling, heating and rolling of sheet bars and sheet packs have been proved feasible during the past two years that they may affect the whole industry.

In order to better understand the nature of these changes and the results attained thereby, let us review briefly the older methods, which are still in general use.

The production cycle under discussion starts at the bar furnace (commonly called the pair furnace) which is ordinarily fired by coal or gas and equipped with a number of small doors along the front and two large doors at the side of the heating chamber. Through these latter doors, bars, cut to proper length, are charged, usually eight to twenty pairs at a time. The bars are laid individually side by side on the floor of the heating chamber and well toward the rear where they remain until they reach proper rolling temperature. They are then brought to the front of the chamber, piled up at one side of one of the small doors, and a new charge is placed, as before, in the rear of the furnace.

When rolling operations are to begin, a helper pulls a pair of bars out of the furnace and drags them across the floor to a rougher, who places them on the foreplate in front of the mill and then passes one bar through the roughing mill to a catcher on the other side. The catcher, using his tongs as a lever on the billy, balances this bar on the top roll until the rougher passes the second bar through and grasps the first bar with his tongs. This process is repeated until the bars are thin enough to be matched and rolled in pairs. When the packs are of proper thickness for the finishing mill, they are stacked for delivery to a reheating furnace.

When the packs have been reheated to the proper rolling temperature in a furnace, which is similar to the pair furnace previously described, a helper, tongs in hand, drags the pack to the finishing roller who starts the pack through the mill, where it is taken by the catcher and returned over the top roll to the roller. This cycle is repeated until the pack has been rolled to the proper length when it is pulled to one side of the cooling floor until it is cool enough to shear.

These older methods are now being superseded, not in sequence or number of operations, but by new types of furnaces and handling mechanisms which eliminate many of the manual operations. These, in turn, speed up production, reduce scrap and, it is claimed, improve the quality of the finished product.

For a matter of comparison, let us briefly review the new mechanical processes.

The sheet bars are brought to the rear of a pair furnace which is of the continuous type, either double or single width, depending on the space available and the operator's preference. Conveyors extend from a loading platform some distance behind the furnace through the heating chambers and discharging doors at the front. Furnace doors, both front and rear, are electrically operated and interlocked with the conveyors so that they operate simultaneously with a movement of the conveyor. During the charging process bars are placed flat on the conveyor which moves forward short distances at a time. This is continued until the furnace is full.

When the bars have been heated to a proper temperature, a pair is discharged at the will of the operator upon a conveyor which carries them to the mill foreplate from which they are fed into the rolls. During this automatic delivery of bars from the furnace following operations take place. The furnace doors open. The furnace conveyor moves forward and delivers a pair of heated bars to a conveyor leading to the mill. After these bars have been delivered funace conveyor stops and both doors close. This process is repeated when the rougher is ready for the next pair. In this whole cycle of furnace operation, it will be noted that manual labor is necessary only in loading the conveyor at the rear of the furnace.

In some mills where these continuous furnaces are being used, the rolling of pairs involves the same manual operations with respect to rolling, matching and rerolling as described with the older methods. There are, however, installations of mechanical catchers with movable conveyors which pick up the bar from the mill and return it over the roll to the rougher.

In the case of a double width furnace with two conveyors, the flights are so interlocked electrically that they will alternately deliver a pair of bars to the conveyors with the same operation of the controls. This insures more uniformly heated bars.

It might be well to digress from rolling operations long enough to discuss one of the reasons why a better product is obtained—namely, the improved furnace construction and temperature regulation. These continuous furnaces are heated by producer gas, natural gas or oil and the temperatures are automatically controlled and recorded by thermocouples attached to accurate, electrically operated, regulating and recording devices. With these modern methods it is possible to hold furnace temperatures to a plus or minus ten degrees, while with the older methods, temperature variations of one

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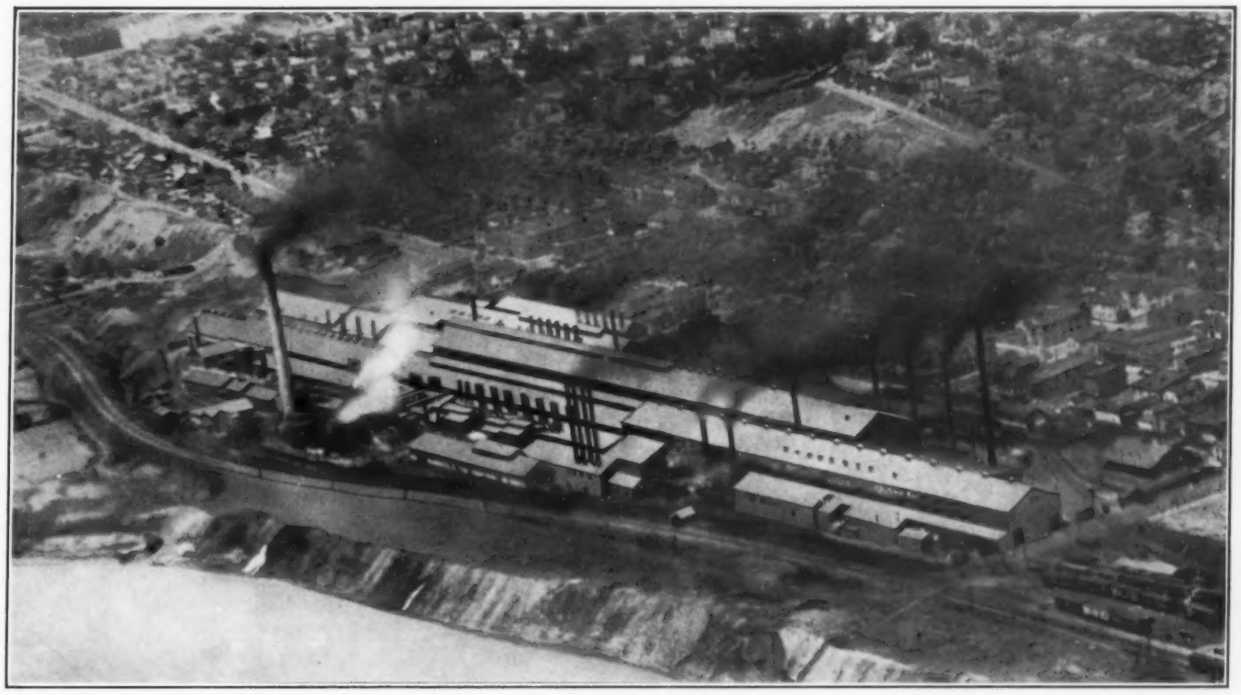


Follansbee, W. Va. Plant of Follansbee Brothers Company Changes From 25 Cycles To 60 Cycles

By J. S. MURRAY*

EDITOR'S NOTE

Mr. J. S. Murray, Chief Electrical Engineer and Special Assistant to the Metallurgist, Follansbee Brothers Company has contributed to the Iron and Steel Industry his most valuable experiences in changing a plant, which operated with 25 cycle, over to 60 cycle, without incurring a single delay in operation or any accidents to employees engaged in this work.

J. S. MURRAY

This engineering accomplishment is to be commended upon when it is taken into consideration that the plant was 100% in operation at the time of the change.

Mr. Murray, in addition to being Chief Electrical Engineer of the Follansbee Brothers Company, specializes in manufacture, research and application of silicon steel sheets to the Electrical Industry.

He is an Active member of the Association of Iron and Steel Electrical Engineers, a member of a number of the National Committees of this Association and has contributed many editorials and papers of engineering merit to the Association's transactions.

The Association of Iron & Steel Electrical Engineers desires to congratulate Mr. Murray on his recent successful accomplishments in connection with his engineering activities at the Follansbee Brothers Company's plants.

*Chief Electrical Engineer, Follansbee Bros. Co., Follansbee, W. Va.

Follansbee, W. Va. Plant of Follansbee Brothers Company Changes From 25 Cycles To 60 Cycles

The Follansbee, W. Va. Works of Follansbee Brothers Company is located on the Ohio River, about twenty miles north of Wheeling, W. Va., in close proximity to natural resources, such as coal, water, gas, oil, electric power, and excellent transportation facilities by rail and river.

Fig. 1 shows a general view of the plant.

The town of Follansbee and the plant were built simultaneously about 1904, and the plant is the only one in the United States devoted to the manufacture of quality tin and terne plate from a forged open hearth steel base. The plant, in addition, manufactures "Follansbee Forge" Silicon Sheets noted for their outstanding characteristics for use in motors, generators, power transformers, radio equipment, and many other devices in the electrical industry.

A modern research laboratory forms a very important unit of the plant layout, and this laboratory is being constantly used to maintain and improve the established high standards of quality of all products manufactured. See Fig. 1A.

FIG. 1A.

The layout of buildings and equipment as it exists today is somewhat similar to the layouts at the Toronto, Ohio, Works, which was described in detail by the author in the 1927 proceedings of the Association of Iron and Steel Electrical Engineers. It is natural that the Follansbee Works, starting as it did very early in this century, adopted steam engine drives for the mills and 25 cycle, 3-phase power to drive auxiliaries. It may be of interest to know also that this plant installed one of the first wound rotor induction motors in the United States to drive a bar mill. This motor was 1000 HP, 83½ RPM, 25 Cycle General Electric, and was installed about 1909. It was re-installed later (1913) on a sheet mill drive using rope transmission.

A reversing steam engine was installed on the bar mill and steam engines were installed on the tin mill drive and cold mill drive; the latter two using rope transmission.

All the engines and 1000 ton forging press operated on 150 lbs. steam pressure condensing to receivers located at the power plant.

Power Plant

The power plant consisted of the usual boiler house. Two 1500 KW, 2200 volt, 3 phase, 25 cycle, low pressure turbo generators with jet condensers, switchboard, and one 500 KW, 250 volt, motor generator set.

The low pressure steam from the engines and press was taken to the receivers and from there to the turbines. The additional steam required by the turbines was taken from the boiler house.

The electric load consisted primarily of the 1000 HP sheet mill motor previously mentioned, condensing and mill supply water pumps, 500 KW MG set and a 750 KVA bank of step-down transformers used to supply power to general purpose motors driving coal grinding equipment and transporting pulverized coal to various heating and annealing furnaces. The MG Set furnished D.C. power for crane and floor motors in the usual manner.

Another boiler house was located near the bar mill and supplied steam to the forging press, bar mill engine, and other process work.

Briefly, this was the general plant layout from a power standpoint early in 1923. The writer entered the employ of the Company in 1919 when construction commenced on the Toronto Works and was requested in 1923 to prepare a study which would help to decide ways and means of overcoming a serious electric power shortage that was in existence at Follansbee Works at that time. During this investigation, which was directed by Mr. C. W. Kinter, Chief Engineer, it was discovered that the turbo-generators were very much overloaded. Also the 500 KW MG Set and the 1000 HP motor was overloaded. In addition, it was found that the power demands on the turbines, both as to magnitude and time, were out of step with the amount of exhaust steam available from the engines and forging press, with the result that the low pressure turbines were taking live steam a greater part of the time resulting in exceptionally high power cost. Also, the layout provided no spare equipment whatever for an emergency.

After a considerable study of the situation in general and the condition of the boiler plants in particular, together with a desire not to make any additions at 25 cycle frequency, it was decided to install a 750 KW, 60 cycle, MG Set and operate it continuously from the 25 KV lines of the Monongahela West Penn Public Service Company, keeping the 500 KW, 25 cycle, MG Set for a spare unit. The operation of this set on 60 cycle, purchased power, temporarily relieved the load on the turbines and proved, as subsequent data will show, to be a very important step in the ultimate solution of the problem because it proved very economical and reliable in operation.

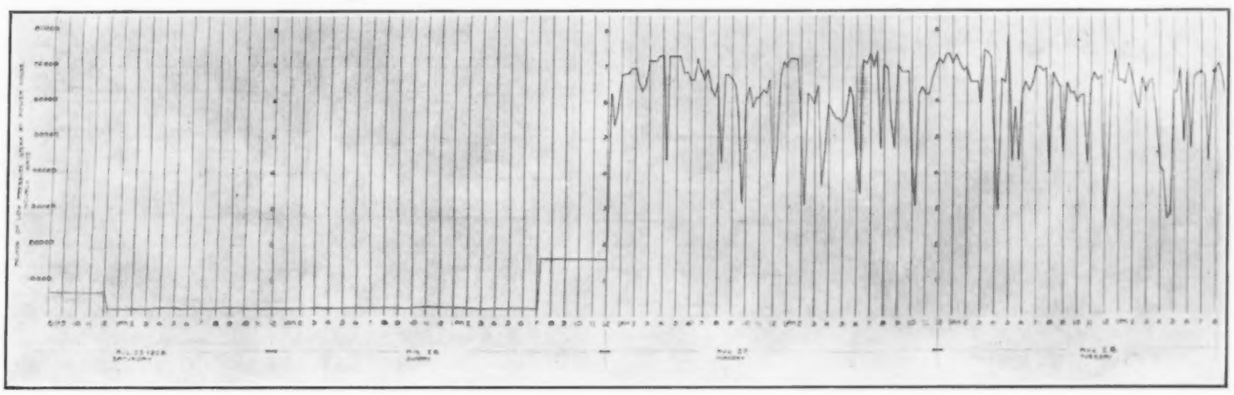


FIG. 2.

In the year 1927 the writer was put in charge of the electrical departments of both Toronto and Follansbee Plants with instructions that one of the major problems to be solved at Follansbee was the high manufactured power cost and very unsatisfactory operation of the turbines and extremely overloaded condition of the 1000 HP mill motor. The condition of the No. 1 boiler house was naturally worse than it was in 1923 so that in general the conditions in 1927 were somewhat a repetition of those of 1923.

Power Investigations

The first step in the solution of the power problems was to determine by what plans the overloaded and costly conditions could be remedied and this finally resolved itself in the following:

Plan 1. Install a new high pressure boiler plant, change main mill drive to high efficiency steam engines and generate all other auxiliary power from new turbines at 25 cycles. Eliminate purchased power for motor generator set.

Plan 2. Install a new mixed pressure steam turbine generating plant at 25 cycles, make no changes in boiler plant, and eliminate purchased power.

Plan 3. Install new 150 lb. pressure boiler plant. Make no change on mills or engines. Present turbines to carry present load. Purchase power as at present.

Plan 4. Install new 150 lb. pressure turbo-generators, leaving all other conditions as they existed, with the exception of the elimination of purchased power and substitution of a motor on the cold mill drive and a large motor on the motor driven hot mill, all at 60 cycles.

Plan 5. Electrify the rolling mills and purchase all power requirements from the Public Service Company.

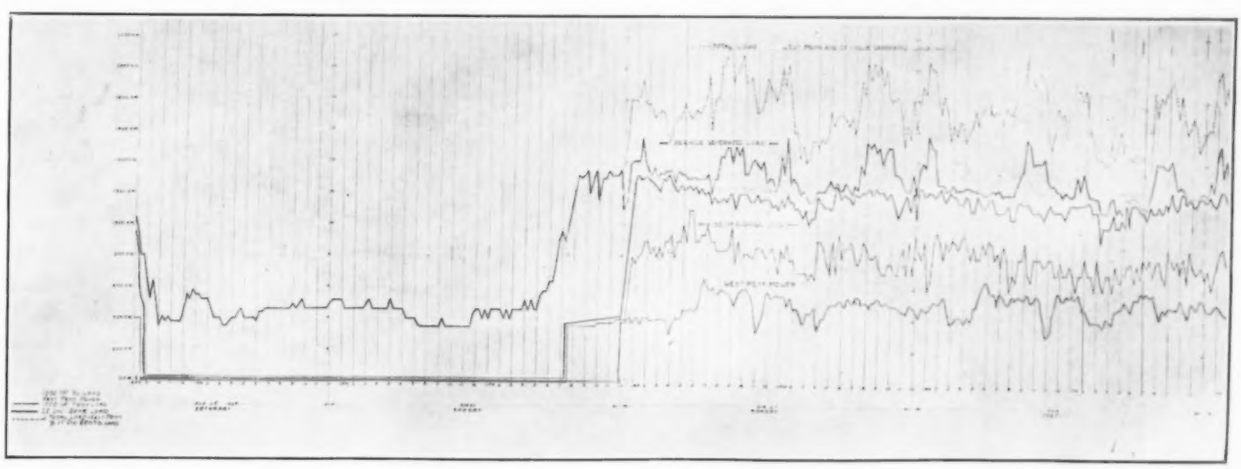
Plan 6. Purchase all power requirements except for one hot mill drive; power for this unit to be supplied from the existing turbo-generators and leaving engine drives as they existed, thus mixing the frequencies.

Plan 7. Purchase all power requirements, except for one hot mill drive; power for this unit to be supplied from the existing turbo-generators, and change other engine drives to electric drives.

Plan 8. Install new boilers and 60 cycle generating station. Electrify all drives except bar mill engine.

Certain of the above plans were immediately discarded because of existing conditions, including one which considered the use of waste heat from the open hearth furnaces. This plan was not even seriously considered because of the small size of the open hearths and the cost of utilizing this heat.

The plan shown as No. 1, which consisted of the installation of a high pressure boiler plant and high



FIGS. 3 AND 4.

STEAM

PRESENT CONDITIONS—AVERAGE MONTH

ITEMS		Average Working Period Hrs.	WORKING PERIOD Quantities	Exhaust Steam Available
(a) Press		570	8,977,000	8,800,000
Press Line Losses			1,350,000	
(b) Bar Mill		570	13,068,000	11,780,000
Bar Mill Line Losses			1,960,000	
(c) Hot Mill Engine		596	10,880,000	9,792,000
Hot Mill Engine Line Losses			816,000	
(d) Cold Mill Engine		594	2,570,000	2,313,000
Cold Mill Engine Line Losses			193,000	
(e) Pickle Plant		600	5,234,000	
Pickle Plant line Losses			1,308,000	
Heating		600	836,000	
Heating Line Losses			84,000	
(f) Electric Plant	759,300 KWH	583		
Electric Plant Line Losses	Included in Meter Reading			
(g) Air Compressors		600	1,920,000	1,728,000
Air Compressors Line Losses				
(h) Miscellaneous Uses			249,000	
Miscellaneous Use Line Losses			223,000	
(i) Bar Mill Pump		520	2,500,000	2,375,000
Bar Mill Pump Line Losses			125,000	
Purchased Power 25,000 V.	314,900 KWH			
NET STEAM USES			52,293,000	
(j) #1 Boiler Plant Steam Used				
#1 Boiler Plant Losses				
#2 Boiler Plant Steam Used				
#2 Boiler Plant Losses				
TOTAL STEAM				
Total Steam Corrected for Superheat				

FIG.

BALANCE

BASED ON FIRST FIVE MONTHS OF 1928

WEEK-END PERIOD		TOTAL MONTH						
Quantities	Exhaust Steam Available	Quantities	Exhaust Steam Available	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
		8,977,000	8,800,000	8,977,000	7,182,000	7,182,000	8,977,000	8,977,000
378,000		1,728,000		1,728,000	1,728,000	1,728,000	1,728,000	1,728,000
		13,068,000	11,780,000	13,068,000	10,454,000	10,454,000	13,068,000	13,068,000
550,000		2,510,000		2,510,000	2,510,000	2,510,000	2,510,000	2,510,000
181,000	163,000	11,061,000	9,955,000	11,061,000	8,849,000		11,061,000	
183,000		999,000		999,000	999,000		999,000	
		2,570,000	2,313,000	2,570,000			2,570,000	
44,000		237,000		237,000			237,000	
		5,234,000		5,234,000	5,234,000	5,234,000	5,234,000	5,234,000
283,000		1,591,000		1,591,000	1,591,000	1,591,000	1,591,000	1,591,000
184,000		1,020,000		1,020,000	1,020,000	1,020,000	1,020,000	1,020,000
18,000		102,000		102,000	102,000	102,000	102,000	102,000
		19,248,000	527,000	19,248,000	24,775,000		1,200,000	6,740,000
					1,264,000			
415,000	373,000	2,336,000	2,101,000	2,336,000	2,336,000		2,336,000	2,336,000
		176,000		176,000	176,000		176,000	176,000
		249,000		249,000	249,000	249,000	249,000	249,000
49,000		272,000		272,000	272,000	272,000	272,000	272,000
		2,500,000	2,375,000	2,500,000	2,500,000		2,500,000	2,500,000
60,000		185,000		185,000	185,000		185,000	185,000
2,245,000		74,063,000		73,786,000	71,526,000	30,442,000	56,015,000	46,688,000
		6,162,000	5,280,000	6,162,000	6,162,000	3,900,000	4,900,000	4,200,000
		1,000,000		1,000,000	1,000,000	502,000	825,000	600,000
		301,000	126,000		301,000			
		170,000			170,000			
		81,696,000		80,948,000	79,159,000	34,844,000	61,740,000	51,488,000
				77,710,000				

efficiency steam engines on the main rolling equipment was also discarded due to the following reasons:

1. No operating advantages over present conditions on the mill.
2. The excessive capital outlay and in addition the high cost of condensing equipment and exhaust lines. A central condensing plant was impracticable on account of the distance between units and the high cost of exhaust lines. Individual high type barometric condensers were also eliminated owing to the fact that they would have to be located a great distance away from the engines due to overhead cranes.
3. Serious loss of production during rebuilding.
4. Much of the new equipment would become obsolete in case new methods of rolling were adopted.
5. Little, if any, reduction in operating costs over the life of the equipment, as no reduction could be made in labor, repairs and maintenance.
6. Practically all savings in fuel and purchased power would be offset by fixed charges on capital required.

Plan No. 2, which consisted of installing a mixed pressure turbine generating plant at 25 cycles was also discarded, for the following reasons:

1. After a study of amounts and time of availability of exhaust steam, it was found that the rate of low pressure supply did not coincide with the electric power demands on the turbo-generators. This condition led to practically full use of high pressure steam.
2. While the total amount of exhaust steam exceeded the requirements for power, it was not available at the time it was needed and the total cost for power, therefore, remained practically the same as in the existing installations.

The availability of low pressure steam is shown in Fig. 2, and as compared with the requirements for power in Figures 3 and 4.

Plans Number 5 and 8 logically divided themselves into two studies:

1. The electrification of mills.
2. Power supply.

The power supply problem was largely decided on the basis of comparison with the Toronto, Ohio Plant, as with like conditions power could be purchased as economically as it could be generated. Therefore, the power supply problem was decided from actual experience in a plant exactly similar and in which is installed modern generating equipment.

In studying the conditions, full tests of all units, both steam and electric, were made, and total amounts were plotted as shown on Figures 3 and 4 for comparative purposes. Fig. 5 shows the steam balances for the proposed plans of operations as well as for the then existing installation. Fig. 6 shows the electric power requirements under each proposed plan.

One of the most important factors developed during the tests which were made and which had been realized for some time before the tests, was that the two turbines would not carry but little over half load. While they were rated at 1500 KW each, it was practically impossible to carry more than 1500 KW on both machines. This was due to the fact that they were both low pressure units to which was being fed mostly live steam at high pressure and was reduced through a throttling valve. Another condition was extremely dirty steam from the exhaust of the engines. These conditions very materially reduced the possible output of these machines and entailed high maintenance costs.

After all test data was assembled a definite cost balance sheet was set up which revealed the following factors:

1. The purchased power rate offered indicated a cost which was comparable with costs obtained in the Toronto, Ohio Plant with like operating conditions of load, where all power is generated with modern equipment.
2. Certain definite savings in labor and operation could be made by entirely electrifying the hot sheet and cold mill drives.
3. Motor equipment could be installed which could be used in case methods of rolling should be changed.
4. Total operation, under purchased pow-

ESTIMATED ELECTRIC POWER REQUIREMENTS

	Plan 4		Plan 5		Plan 6		Plan 7	
Drive	Kw. Hrs. 2200 V.	Demand KW 2200 V.	Kw. Hrs. 2200 V.	Demand KW 2200 V.	Kw. Hrs. 2200 V.	Demand KW 2200 V.	Kw. Hrs. 2200 V.	Demand KW 2200 V.
Hot Mill No. 1	391,300	921	391,300	921			391,300	921
Hot Mill No. 2			391,300	921				
Coal Plant	156,000	259	156,000	259	156,000	259	156,000	259
River Pump	157,300	348	88,500	165	88,500	165	88,500	165
Plant Water Pump	33,800	112	33,800	112	33,800	112	33,800	112
Cold Mill	109,000	183	109,000	183			109,000	183
Air Compressors			60,000	100				
Bar Mill Pump			40,000	70				
Purchased Power	343,800	763	343,800	763	343,800	763	343,800	784
Total at 2200 Volts	1,191,200	2,586	1,612,900	3,494	622,100	1,299	1,122,400	2,424
Power Factor		Unity		Unity		Unity		Unity
Total at 25,000 Volts	1,230,000	2,640	1,663,000	3,560	641,000	1,330	1,158,000	2,480

FIG. 6

er, would show considerable savings over the existing operations and considerable less cost than under any other possible plan of operation.

5. Changes could be made with purchased power with no loss of production, which at that time, was an important factor.

6. All proposed plans, except the first two, showed a large reduction in operating costs when compared with the existing installations.

7. Purchased power would show the greatest return on the investment required.

8. Under the conditions as they existed and with the rapid changes being made in the art of rolling, it was not desirable to spend a large sum of money in power plants and equipment that might, within a short time, become obsolete.

9. Waste heat could not be utilized due to small open hearth furnaces and excessive cost of utilization.

10. Time of availability of exhaust steam made its use questionable and costly.

After a thorough study of all the different conditions, it was decided to purchase all power at 3-phase 60 cycles, discontinue the use of all 25 cycle motors and 25 cycle turbines, hot and cold mill engines and No. 2 Boiler House, and retain the steam engine on the reversing bar mill. No. 1 Boiler House was retained to furnish steam for the bar mill engine, forging press and other heating and process work. All this was authorized with the stipulation that all changes must be made without loss of production, which was 100% at that time and until several months after the electrification was completed.

In 1923, when the 750 KW MG set was installed, it was connected to the Public Service Company's lines through an outdoor substation and high interrupting capacity oil circuit breakers on the 25,000 volt side. Therefore, this sub-station was modified to meet the new conditions as follows:

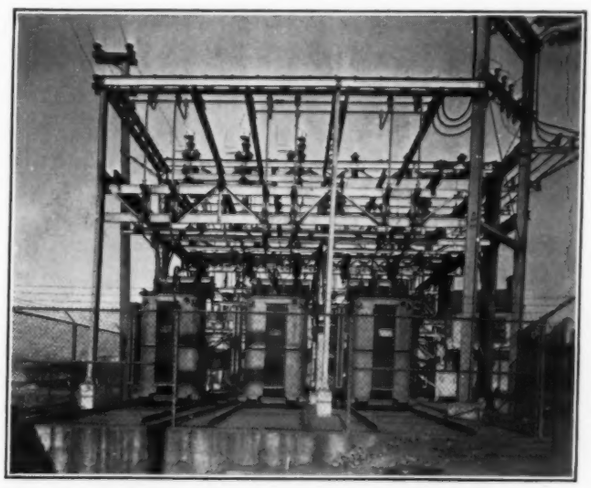
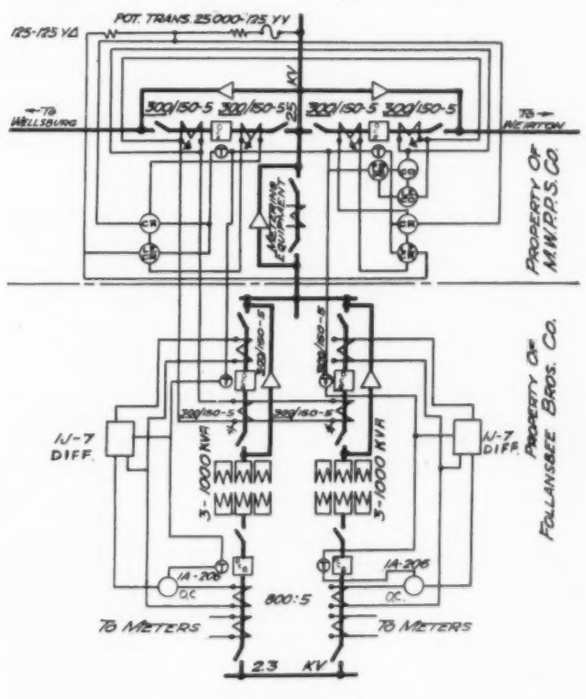


FIG. 7.

Outdoor Sub-Station

The outdoor sub-station is located near the power house and is supplied with a 4/0 3-phase 25 KV feeder from the north through the Weirton, W. Va. sub-station, and from the south through 4/0 feeder from Wellsburg, W. Va., substation. Both 25 KV feeders are tied together through two outdoor type 37 KV Condit switches of some 800,000 KVA interrupting capacity at rated voltage. The tie breaker structure, tie bus, lightning arresters and meter structure were installed by the Power Service Company adjacent to the Follansbee sub-station.

The Follansbee sub-station consists of six 1,000 KVA, 25 KV to 2.3 KV single phase oil insulated air cooled Moloney power transformers equipped with conservator tanks, ratio adjustors and 2½% taps above and below normal voltage. The steel structure and all high and low tension bus work was installed by Follansbee Brothers Company, and the existing oil switches were so arranged that one was used on the high tension side of each of the two banks of transformers. These switches are Type FHKO, 600 Ampere, 37 KV having a published rating of 40,000 amperes and an interrupting capacity of 800,000 KVA at rated voltage. All high and low tension bus equipment on both Follansbee and the Public Service Company structures was manufactured by the Railway and Industrial Engineering Co. All 25 KV busses are ¾" IPS copper tubing and all low tension busses are 2" IPS copper tubing.



SINGLE LINE WIRING DIAGRAM

FIG. 8.

The 2300 Volt busses lead to 2- 3-phase 1,000,000 c/m V. C. insulated copper feeders overhead on steel towers to the main switchboard in the power house, a distance of about one hundred feet, where transformers are parallel through two indoor oil circuit breakers described later. All control cables leading from the outdoor sub-station oil switches, meter equipment, current transformers, and protective and differential relays are lead-covered, encased in steel conduit, and located in a concrete trough in the mill

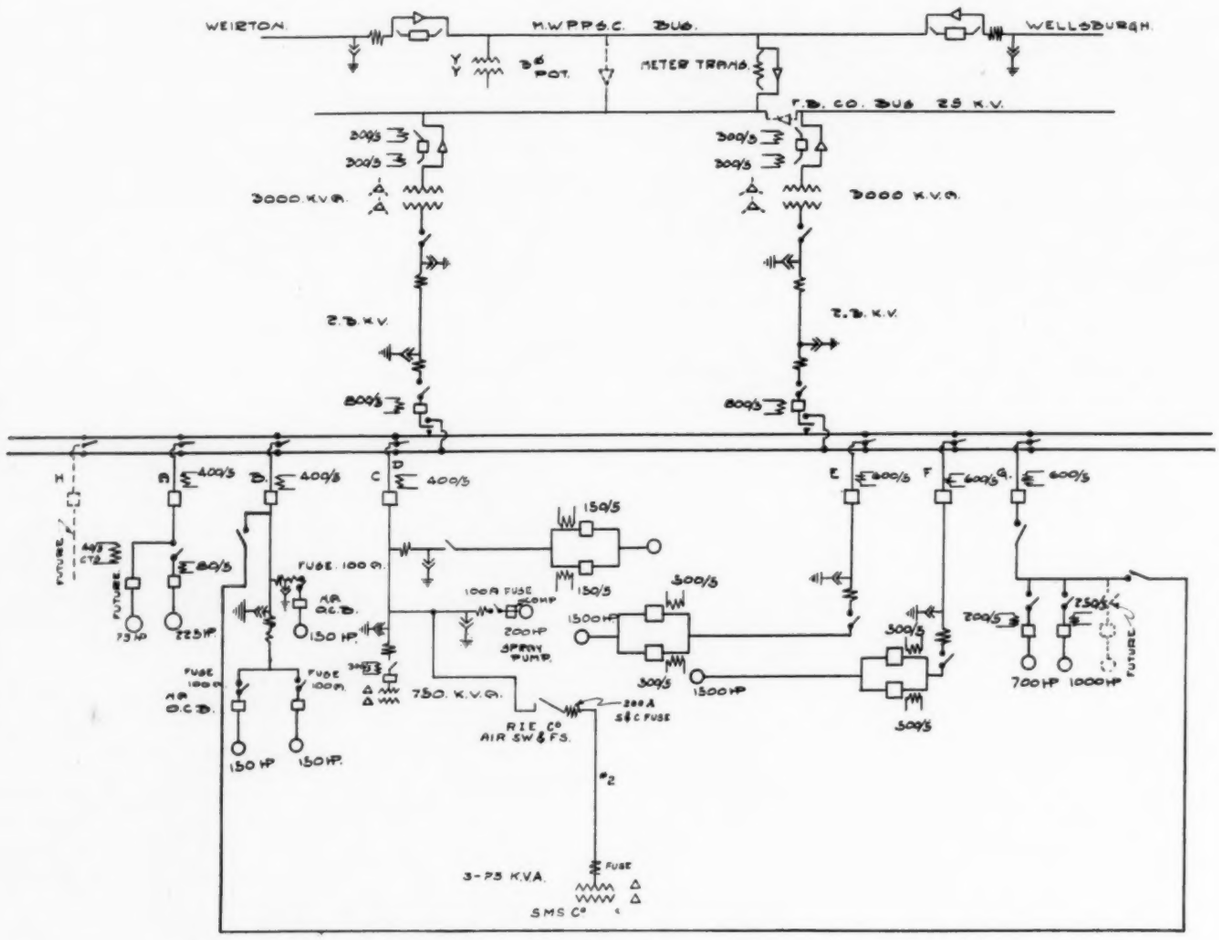


FIG. 9.

yard. The various circuits terminate near the control panels on the main switchboard in the power house. Fig. 7 shows views of this outdoor substation and Fig. 8 shows a single line diagram of the 25 KV and 2.3 KV system. Fig. 9 is a diagram of the bus, line and transformer protective relay scheme used. It was necessary to maintain 25,000 Volt service to a bank of three 400 KVA power transformers for the 750 KW MG set installed in 1924 while all this work was in progress. This proved to be a very difficult and unsafe task and it may be of interest to state here that the entire electrification of this plant was completed without a single lost-time accident.

Main Switchboard

The main switchboard is located in the same location as was the 2300 Volt switching equipment for the 750 KW 60 cycle MG set, also the 2300 volt 25 cycle Turbines, MG set and D.C. switchboard. It was necessary to keep both MG sets available for service, and also the direct current panels, while the new switchboard was being installed, as no changes whatever could be made until the new switchboard was energized. The space available for the new switchboard was, as is usually the case, inadequate under the circumstances.

The board proper consists of ten fabricated semi-enclosed steel structures, with oil circuit breakers for both incoming transformer feeders, double bus, selector type diconnects, and all outgoing feeder oil

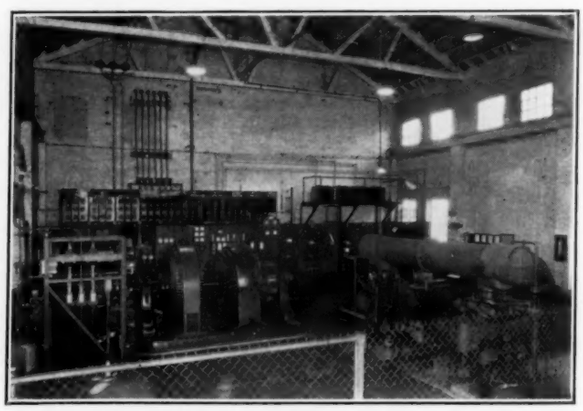


FIG. 10.

circuit breakers, including two automatic starting panels for both motor generator sets.

The new panels consisted of seven steel 3-circuit panels, two panels for the Public Service Company control and protective apparatus and two panels for

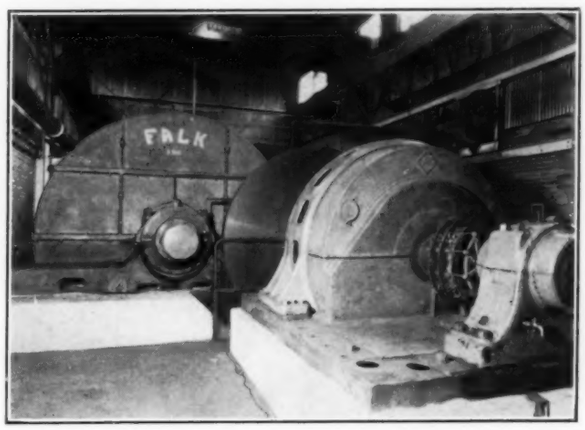


FIG. 11.

Follansbee Brothers Company transformer banks and station storage battery for control of all outdoor and indoor oil circuit breakers. All of this new steel switchboard was lined up and matched with the existing direct current panels for all outgoing direct current feeders to the mill. The two oil circuit breakers on the incoming transformer lines are FK132B-1200A 7,500 Volt, and all feeder breakers are FK132B 600 Ampere 15,000 Volt, all electrically operated from 60-cell KFX Exide storage battery. All feeder breakers are equipped with induction type overload relays and have a rupturing capacity of 17,500 Amperes at 2,500 Volts and a short time carrying capacity of 30,000 amperes, all of General Electric manufacture. Fig. 10 shows a general view of this switchboard.

All outgoing feeders are 3-conductor 500,000 c/m V. C. lead-covered cables, in steel pipe and weatherproof pot heads, and conveyed on steel towers above locomotive crane levels. The cable on towers is 500,000 c/m V. C. weatherproof braid, 7,000 volt, suspended on pin type insulators. The incoming feeders from transformers to power house are suspended in the same manner.

Construction work on this switchboard and outdoor sub-station was done under very unusual handicaps, because of the fact that both 25,000 volt lines and bus, together with 2,300 volt system at both frequencies, had to be maintained in service, and with very limited space.

After the outdoor sub-station and main switch-

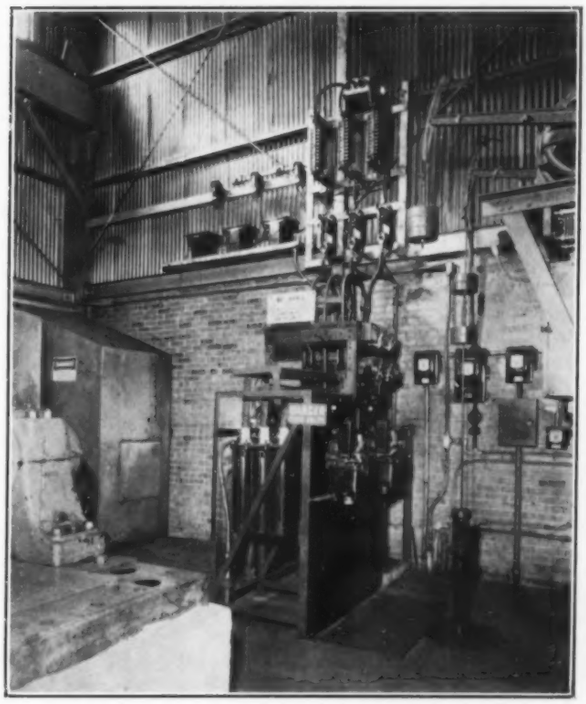


FIG. 13.

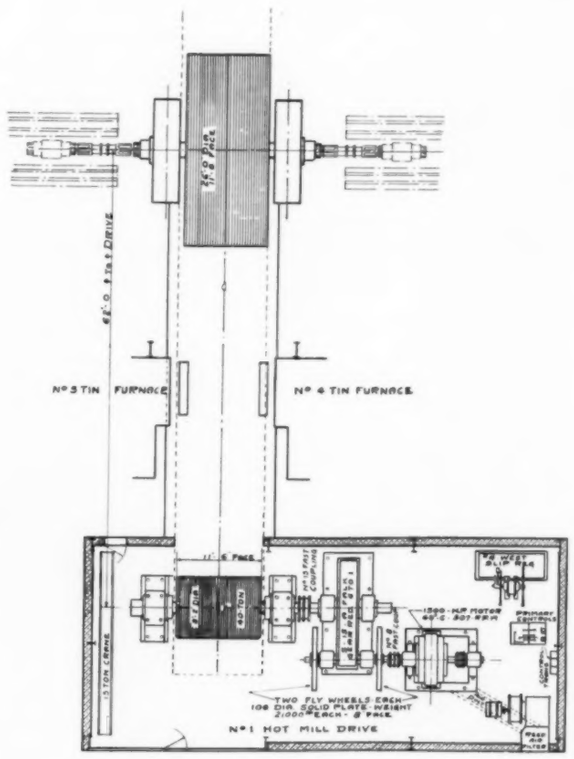


FIG. 12.

board were completed and energized, the 60 cycle MG set was connected to same and the 25 cycle set was dismantled on a week-end and new 60 cycle stator and field coils were put on the (one piece) shaft, and this set was connected to the 60 cycle system.

Provision was made in laying out the main switchboard for the future operation of one or two 60 cycle turbo-generators located in the same building so that in the event it was found advisable to install high pressure bleeder or back-pressure turbines or straight high pressure turbines and boiler house later on, they could readily be connected to this switchboard instead of the main transformer feeders as at present. The bleeder or back-pressure turbines would furnish low pressure steam for the engine at the bar mill, press and other process work at 150 pounds pressure.

Hot Mill Drives

In the electrification of the hot mill drives, it was

considered advisable for several reasons to retain the rope drives, yet on the existing installations of engine and 1,000 HP 25 cycle motor the ropes seriously interfered with crane service and occupied valuable floor space. Besides, the electrification at 60 cycles had to be made without any loss of production. Therefore, it was decided to install new motor rooms on the opposite side of the hot mill building and install the following in each room:

Mill Type 1500 HP 40 Deg. C. 2300 Volt 3-Phase 60 Cycle Wound Rotor Induction Motors, 514 RPM —Allis-Chalmers Manufacturing Company, totally enclosed with automatic American Multi panel air filters and Westinghouse automatic liquid slip regulators and electrically operated oil circuit breakers. The forward and reverse oil circuit breakers on each motor are exact duplicates of the feeder switches at the power house and the feeder cable entrance and insulation is also the same as at the power house. A 6 to 1 herringbone gear unit, with rope sheave, is installed directly in line with the large rope sheave on the mill roll train. Fig 11 shows view of one of these drive units, and Fig. 12 shows a plan view of motors, gears, fly-wheels, couplings and pulleys, with engineering data, etc. Fig. 13 shows view of Circuit Breaker.

After one of these units was ready for operation, the ropes were simply taken off the 1,000 HP motor drive on a week-end and put on the new unit and rolling operations were resumed. The same procedure was followed in the case of the engine drive, except that the small rope sheave wheel, pillow block bearings and liquid slip regulator were taken off the old 1,000 HP drive and installed on the new drive before the tin mill engine was discontinued.

The tin mill drive contains six stands of tin mills, 28" diam.x38" long and four stands of sheet mills, 30" diam.x42" long. The latter are equivalent to two stands from a power standpoint, or a total of eight stands and two drag rolls.

The sheet mill drive consists of ten stands of sheet mills, average size 30" diam. 46" long, five roughing and five finishing, with four stands of cold rolls average size 30" diam. 60" long, two on each end. This is probably the longest hot mill train in service, yet the horsepower requirements are normal, because the method of rolling is known as the "tight mill" method, i. e., one crew uses roughing and finishing stand alternately, so that the power requirements are much less than would appear at a glance.

The bearings on the gear units and rope sheaves are provided with forced feed oil lubrication through Bowser Filter System and the motor bearings are also provided for forced feed lubrication, but plain oil ring feed is used.

The mill motors can be stopped from several points along the mill housings, but must be started from inside the control rooms only. Fig 14 shows the schematic of control system used. Fig 14A shows general view of sheet mills.

Frequency Change

After the 1,000 HP drive and the 25 cycle motor generator set was transferred to the 60 cycle system, one of the 25 cycle turbo-generators was shut

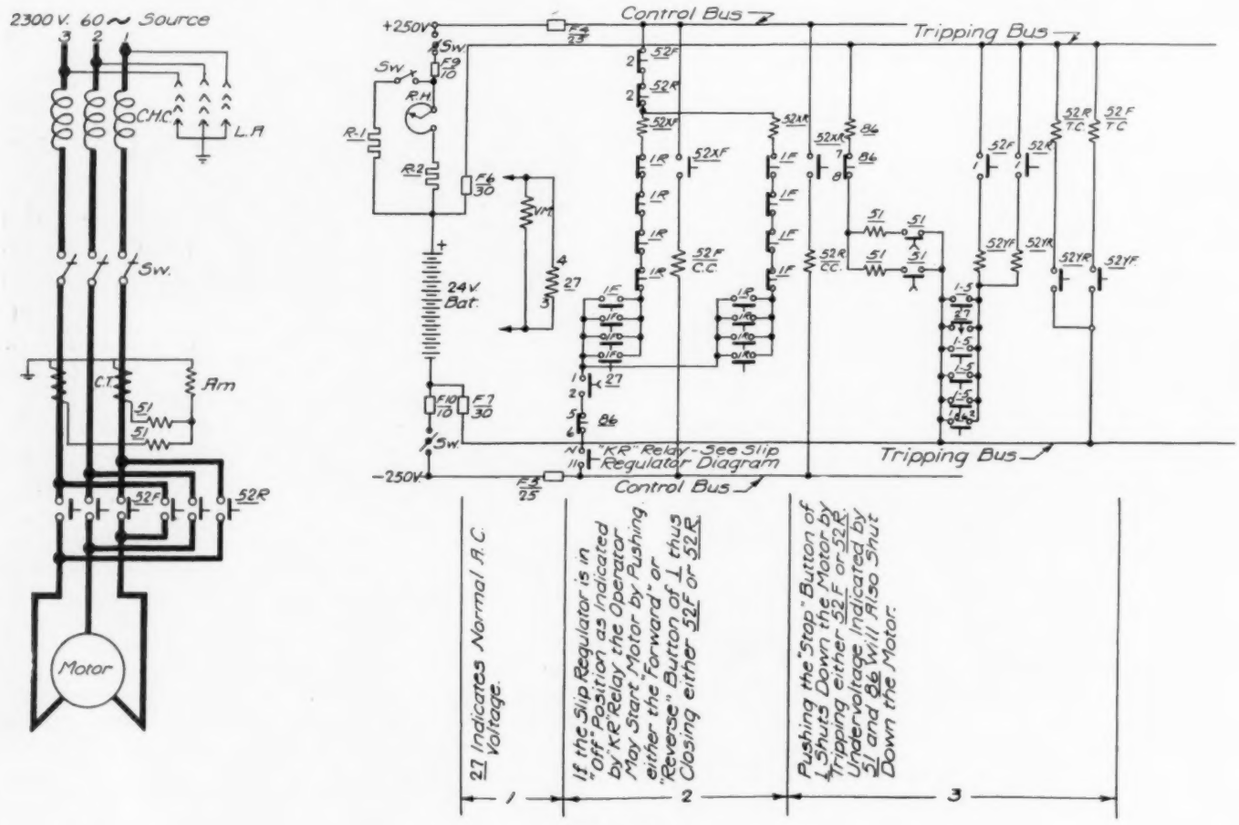


FIG. 14.

down and was to be dismantled immediately after all other 25 cycle motors were changed to 60 cycles. This job of changing about one hundred and twenty-five—25 cycle general purpose 230 Volt motors to 60 cycle ranging from 5 HP to 200 HP located throughout the plant and supplied from the 25 cycle transformer bank mentioned previously, proved to be the most difficult part of the program. The three 2300 Volt pump motors were rewound for 60 cycles, with a slight change in the rating.

FIG. 14A.

The question of the plant power factor was carefully considered in making this change by adding considerable synchronous motor equipment in sizes 75 HP and up, together with a cold roll drive motor and additional new pump drives to be mentioned later on. It was desirable to use the bank of transformers previously mentioned on 60 cycles and, of course, it was very necessary to raise the power factor of this bank from 60% to at least 95% to 100% in order to confine the regulation to permis-

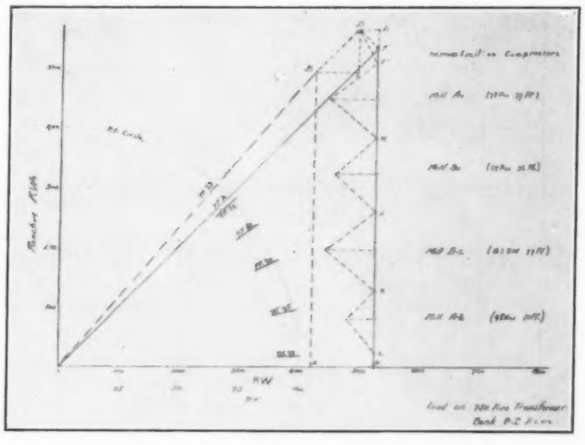


FIG. 15.

sible limits when changing from 25 to 60 cycles. All new motor speeds and ratings were carefully checked and all equipment and construction details worked out in advance, such as mechanical modifications, pulleys, pinions, couplings and starter modifications. A bank of transformers was borrowed from the power company and set up in a central location and a temporary 3-phase 60 cycle feeder run to certain sections of the plant and such sections were gradually changed over to 60 cycles. After all motors were changed, the old 25 cycle bank of transformers was put in service and operated very satisfactorily. All motors were changed without a single delay on production or a single case of trouble on any of the motor drives changed. All induction motors installed are Reliance Electric and Engineering Company, Master Electric, and Ilg Mfg. Co. products. It was now possible to dismantle the first turbo generator taken out of service and to

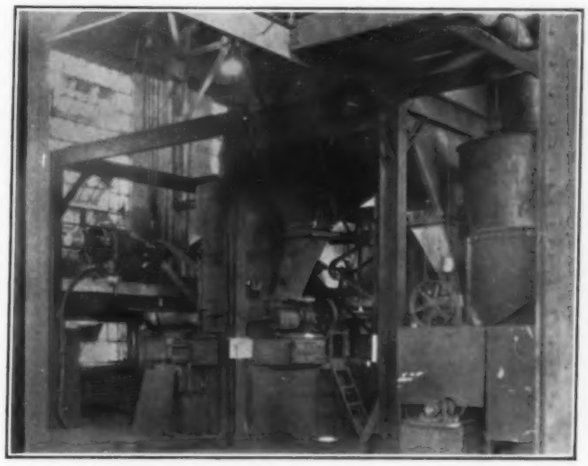


FIG. 16.

shut down the second one. A new 60 cycle .8PF synchronous motor-driven air compressor was installed in the place of the turbine, and it was now possible to shut down three small steam-driven compressors in the power house. The remaining turbo-generator was removed later on and the electric

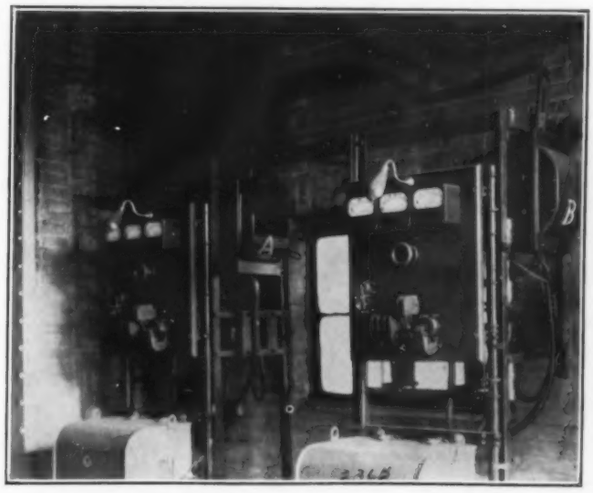


FIG. 17.

repair shop crew moved into this space, so as to utilize crane facilities and the service of the three switchboard operators as repairmen-helpers when not occupied in operating the board, motor generator sets and air compressor, all of which are in the same building. All turbine room labor previously required was dispensed with.

It may be of interest to state here that prior to

the frequency change the load on the bank of transformers mentioned above was 750 KVA at 65% PF and that the peak loads which occurred twice daily invariably occurred at a time when they would be very detrimental from a demand standpoint under the changed conditions, besides the voltage regulation of the 25 cycle transformers at this poor power factor would be prohibitive when operating at 60 cycles. This regulation could be corrected by the purchase of new transformers but the peak and poor power factor would still remain. The principal offender as far as power factor was concerned in the

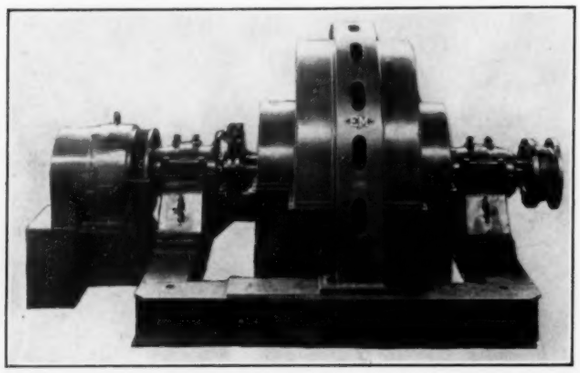


FIG. 18.

coal plant were four 100 HP squirrel cage induction motors, 495 RPM on coal pulverizers and 2-75 HP squirrel cage induction motors driving air compressors.

Therefore in planning the frequency change on these units, load tests were made and estimates of corrective KVA required were checked by the use of the power triangle as shown in Fig. 15. It was decided to install 3-100 HP 720 RPM, 220 Volt 80% power factor motors on the pulverizers using existing hand compensators in conjunction with Auto-

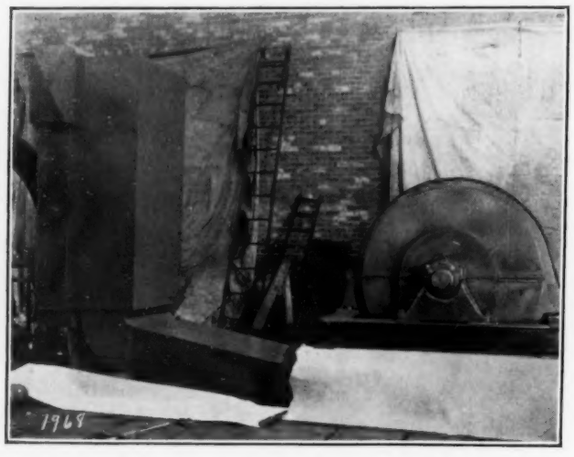


FIG. 19.

matic field control panels while the remaining unit was rewound for 60 cycles and held as a spare pulverizer unit. These synchronous motors are starting the pulverizers, loaded with coal, with 170 volt tap on the starters and the control is equipped with a feature which allows the motors to synchronize at a definite speed regardless of load or to resynchronize after a momentary dip in voltage or overload, Fig. 16 shows view of one of these pulverizer units.

It was also decided to install 75 HP 80% PF 220 volt, 900 RPM synchronous motors on the air compressors having somewhat similar control equipment. Fig. 17 indicates view of control equipment.

By increasing the power factor of the transformer bank, carefully rating the new 60 cycle motors and improving the load factor it was found that some 300 KVA capacity was reclaimed for future use, part of which has been used to good advantage on additions of sheet mill auxiliary equipment while it is possible to still further lead the power factor if necessary as may be seen from Fig. 15.

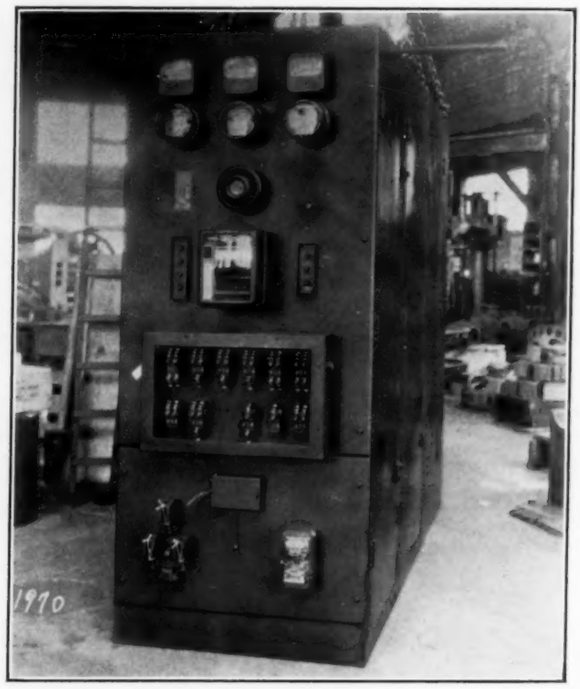


FIG. 20.

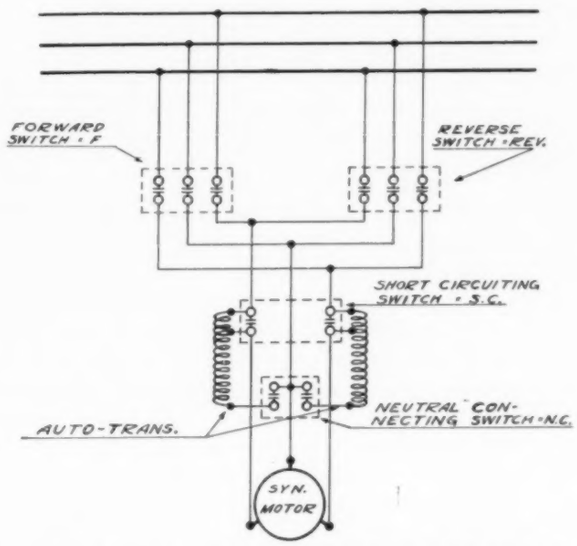
Cold Roll Drive

As has been mentioned before, in the selection of motor equipment on the basis of purchased power, the resultant plant power factor had to be taken into account. With his in mind it was decided to convert the steam drive on the cold roll mills to a leading power factor synchronous motor. See Fig. 18. This decision was made after the old engine had been indicated under various conditions of load. The indicator charts showed the load to be fairly constant under normal operation with an indicated horsepower of about 350. The starting conditions, of course, were more severe and indicator charts showed 790 HP during starting and a period of one minute to accelerate to normal speed. The engine had quite a large fly-wheel to accelerate in addition to the friction load of the mills, which, of course, required considerable power but was necessary to smooth out the pulsations of the steam engine.

In considering the electric drive, it was decided

that the flywheel was not necessary and its removal would not only reduce the required starting torque but would also decrease the time of acceleration. The synchronous motor would provide constant speed and there was sufficient WR^2 in the motor and drive to keep the current variation from being excessive. It was then decided from the horsepower and the corrective KVA required to use a 500 HP synchronous motor having a starting torque of 150%, pull-in torque of 120% and pull-out torque of 250%. This motor would have a normal load of about 250 KW and would supply a corrective KVA of 312 which was very desirable from the standpoint of power factor correction.

The next point considered in the selection of this motor was the type that could be put in without delaying operation during the period of installation. As this motor was to drive two rows of stands in



SWITCH CONNECTION DIAGRAM
KORNDORFER METHOD
OF
STARTING WITH AUXILIARY SWITCH
FOR
REVERSING

FIG. 21.

tandem, eight stands total, the first motor considered was a slow speed pedestal type motor direct-connected to the two rows of stands by means of a double-speed reduction unit. This motor would do away with the rope drive and occupy a minimum of space, although there was no available space for this motor, as the steam engine occupied the place where the motor would have had to be located. As this was out of the question, it was necessary to consider other possible layouts. It was finally decided that the conditions could be best met by the installation of a 514 RPM motor coupled to a gear reducer to drive the stands with the same rope drive used on the steam engine. This rope drive had been in use for a number of years and had given very little maintenance trouble. It could readily be adapted to the motor drive and the change could be made from steam to electric with the minimum of delay. After considering the various possible types of drives and specifications submitted by manufacturers, it was therefore decided that the motor selected would be an Electric Machinery Manufacturing Company 500 HP, 80% power factor, 514 RPM, 3-phase, 60 cycle, 2200 Volt, coupled, two-pedestal type, totally enclosed motor, with direct-connected exciter. The motor had to be totally enclosed, as the location is such that the dust in the air would be likely to cause considerable annoyance, if not trouble, with an open type electric motor. The enclosed type of motor, of course, would have to be supplied with

FIG. 21A.

clean air, so it was decided that the most suitable method to use in obtaining this air would be by means of an automatic American Multi Panel air filter, installed close to the motor. This ordinarily would require an additional fan motor and auxiliary equipment, but the motor company suggested that they design the motor to draw its own air through the filters and duct and in that way dispense with

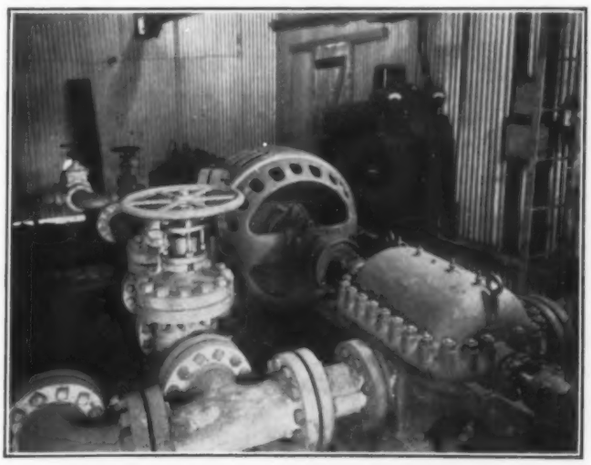


FIG. 22.

the unnecessary auxiliary equipment. Their suggestion was approved, and from data supplied by the Air Filter Company in connection with their equipment, and their own engineering data on the motor, it was so designed and a filter was supplied for the motor and one for the exciter. See Fig. 19.

In order to secure the proper control for the above motor, it was necessary that the motor could

be inched forward and reversed in order to line up rolls, etc. As the high speed and starting torque of the motor would result in a comparatively high KVA inrush on across-the-line starting, it was decided that the motor control be provided with reduced voltage starting with emergency full voltage start and that the starting be of the closed transition type so that the motor would not be disconnected from the line during the starting period. Another feature of the control is that the motor would synchronize at a definite speed regardless of the load encountered in starting. This is accomplished by a frequency relay, which also enables this motor to be pulled out of step and re-synchronized without shutting down the mill to re-start the motor. See Fig. 20. Fig. 21 indicates details of closed transition control. Fig 21A is a general view of this mill. This cold mill train consists of 8-24" diam. 50" long roll stands in tandem.

It required four and a half days to remove the engine and install the motor and gear unit, using the existing rope drive. This unit has given complete satisfaction and can be started either on reduced voltage or full voltage, without any noticeable line or system disturbance and at somewhat less than the calculated in-rush values. The cold roll and tin mill engine operators were dispensed with after this change was made. No. 2 boiler house and the remaining 25 cycle turbine was removed from service at the same time.

General

Several other additions were made on the 2300 Volt system, among which may be mentioned an ideal drive where additional corrective KVA could be supplied by the installation of a 200 HP 80% power factor, 1800 RPM synchronous motor, direct-connected to double unit high pressure centrifugal pump used on the 30" bar mill. This motor is controlled by an Electric Controller & Mfg. Co., high voltage compensator. In addition to driving the mechanical load, the motor supplies some 125 KVA for power factor correction. Fig. 22 shows a view of this unit.

The total plant load of the Sheet Metal Specialty Company, a subsidiary of Follansbee Brothers Company, located near the steel works, was added to the mill system, totalling some 225 KVA. The average total demand under the new load conditions is 3800 KVA.

In conclusion, it may be said that the following are some of the results of this electrification program:

(a) Considerable reduction in power cost.

(b) Considerable reduction in operating forces formerly required on engines, boilers and turbine room.

(c) Substantial floor space released for manufacturing purposes formerly occupied by engines and transmission ropes.

(d) Elimination of great losses in long steam lines.

(e) Elimination of old boiler house entirely and considerable reduction of steam output of the remaining No. 1 Boiler House.

(f) Increase of plant power factor from 60% to 100%.

(g) Elimination of 25 Cycle frequency, thus permitting very important consolidations of all equipment and resources of the Electrical Departments at both the Follansbee and Toronto Works.

(h) Reasonable 25,000 Volt transformer capacity available for the future.

(i) The new layout permits the installation of modern high pressure boilers and turbo-generators at any time in the future, if desirable.

(j) Substantial reduction of Electrical Department forces, because of modern equipment, shop re-arrangement, and consolidation with similar departments at Toronto.

(k) Less time of management devoted to power problems and diverted to other and more appropriate problems.

In these days of modern equipment and proper engineering, in original selection and scheduled maintenance in a systematic manner, it is very economical to consolidate electric maintenance departments in a group of plants where equipment is standardized as to frequency, voltage, major mechanical dimensions, ratings and speeds, so that very substantial savings can be made in maintenance costs. For example, the repair shops of our Toronto and Follansbee Works are consolidated, our electrical equipment is interchangeable, and a large part of our mechanical equipment on cranes is interchangeable. Between the plants, our crews are diversified so that certain requirements inherent in the plants can be met in the most economical way. This method also reduces spare parts carried in plant storerooms, and in the case of some commodities, confines them to one of the plants, so that in general it can be said that men, methods and materials can be used to the fullest advantage.

The decision to electrify the Follansbee Plant was made on March 13, 1929, and the work was completed on December 24, 1929, and up to the present time there have been no power interruptions on the 25 KV system.

This work was under the general supervision of Mr. C. W. Kinter, Chief Engineer. The writer wishes to express his appreciation to his fellow workers in all departments of the plants for their splendid cooperation, and also to the Construction Department of the Monongahela West Penn Public Service Company, Wellsburg, W. Va., and to the various manufacturers of electrical equipment involved in the work.

An Electrical Development Which Is Producing Quality and Uniformity of Product in The Bessemer Process

Richard S. McCaffery, Professor of Metallurgy, University of Wisconsin, outlines a new electrical development in connection with the Bessemer process in his paper "The Bessemer Process and Its Product" presented at the Fall meeting of the American Iron & Steel Institute in New York, October 23.

Mr. McCaffery laid special stress on an electrical development in connection with Blowing Equipment.

At a prominent steel plant a recent installation of electrically driven blowing equipment has proved very successful. Each converter is provided with an individual motor-driven centrifugal blowing unit on an individual air line to the converter. The equipment is arranged so that any blower may be connected with any converter. The control of these blowers is entirely from the blowing pulpit. The operators start or stop the machines, or increase or decrease their speed, as the necessities of the blow may require. The operator has a pressure gauge, a volume meter and a tachometer on the board in front of him along with the start, stop and speed regulation buttons. There has never been possible in this country the exactness of control of the converter now realized in this plant.

To illustrate the control that it is possible to obtain, Fig. 1 [1] shows the recorder chart made on two soft steel blows, the one blow maintaining constant pressure, after the period of cold metal additions to the end of the blow, and the other blow similarly maintaining constant volume for the same time. The data from Fig. 1 are redrawn in Fig. 2 for the blow at constant pressure and in Fig. 3 for the blow at constant volume.

In addition to the nicety of control of the operation now possible, these curves bring out some facts not generally known until now regarding the bessemer blows. In Fig. 2, where constant pressure was maintained from the time when cold metal additions had been completed, it will be noted that the volume remained practically constant in the early part of the blow, but in the latter part the volume increased rapidly from 18,000 cubic feet per minute to 30,000 cubic feet per minute, although the pressure remained the same. In this case, while maintaining constant pressure, the volume increased at the end of the blow by about 60 per cent. It will be noted too that the slope of this volume curve decreases and flattens out just before the turn down.

Fig. 3, plotted similarly with volume kept constant, shows corresponding pressure decreases.

This variation of metal bath resistance to the blast is caused by the changes in viscosity of the bath because of changes of composition and temperature and also by the increase of weight of the bath due to formation of silica and other oxides in the early part of the blow and to a decrease in bath weight due to the elimination of carbon toward the end of the blow.

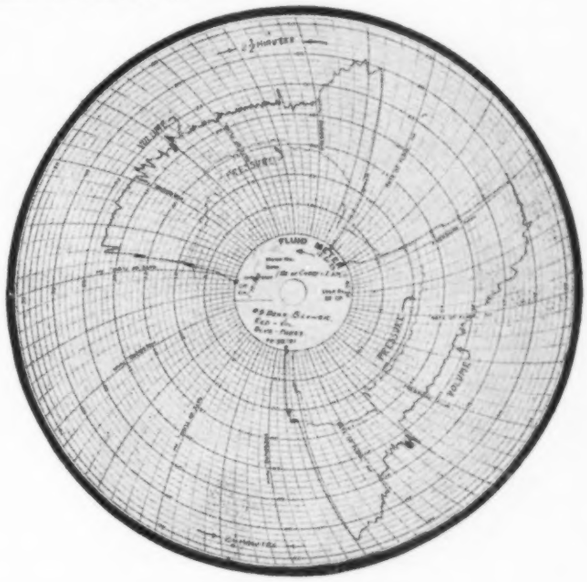


FIG. 1.

In Fig. 2 the point at which the increase of air volume takes place when operating at constant pressure is the place where "spitting" begins in the usual spitting blow. While the heat illustrated in Fig. 3 was blown and the blast volume was maintained constant, a second converter was charged with metal from the same mixer about five minutes after the first converter received its charge. This latter heat was given the same cold metal addition but was blown so as to maintain fairly constant pressure. The blowing time of the two heats was exactly the same, but the heat blown while maintaining the blast volume constant did not spit at all, while the second blow with practically identical metal charge, same initial temperature, same weight of metal, and same cold metal addition as the first but with the large increase of blast volume at end of blow, "spit" badly.

These special blows, which illustrate the blast volume and blast pressure changes during a bessemer heat, also demonstrate a fact that is extremely important in its effect on product uniformity and quality. A chemical change in the molten metal bath can be noted practically the instant it occurs by means of the pressure gauge; such changes are indicated by the Points A and B in Fig. 2. The instant they are noted, a change can be made in the rate at which oxygen, the chemical reagent, is added by increase or decrease of blast pressure or volume or both, and this change of rate can be made in a few seconds.

1 The mechanism for the more rapid drive of the chart makes the marked interval of one hour on the chart actually represent about 2.5 minutes, rotated anticlockwise. This must be allowed for in examining the chart.

Old type installations where perhaps a number of blowers discharged into a common blast main which in turn might serve two or more converters rendered impossible any regulation of pressure and volume to the individual converter and thus made it impossible to secure the highest and most uniform quality of product.

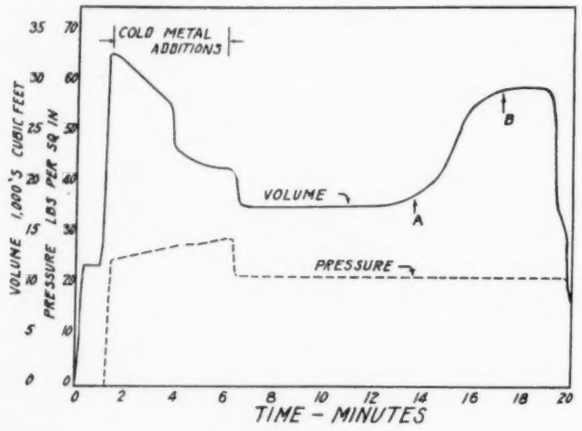


FIG. 2.

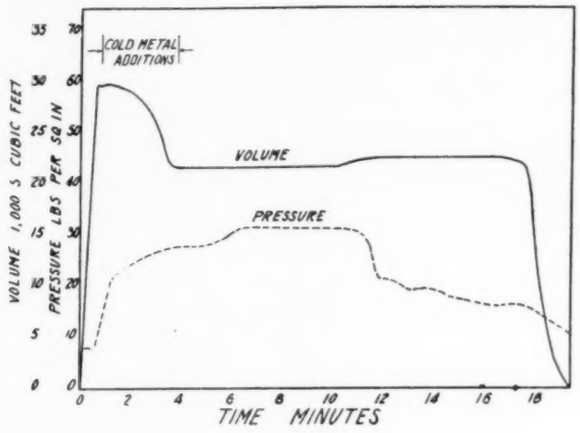


FIG. 3.

This high quality and uniformity of product can only be obtained when the factors of control can be exercised. This is possible only with the use of modern equipment.

Technically a metallurgical process possesses no virtue, nor is it lacking in virtue, by being fast or slow. The essential points are whether the process is controllable, how quickly this control can be exercised, and how rapid is the response. The situation in bessemer some years back, compared with bessemer today, is somewhat like the situation with respect to automobile speed. Twenty-five miles an hour might have been a fair average road speed years ago; a driver did not have good roads and he was uncertain about his machine and himself. Today where there is no legal maximum speed the average road speed may be fifty miles, but the driver has a concrete road protected at crossings, has a machine the performance of which is reliable, and he has trained himself to react correctly and rapidly to the road situations which develop. The bessemer process has done a similar thing during the same time, but in the case of the bessemer process the accomplishment has been with respect to uniformity and quality of product.

Air Conditioning Equipment

In the various papers appearing in the Iron and Steel Engineer on air conditioning equipment all were very interesting; each one of the authors emphasized different things but, in general, all described very well their various lines of air conditioning means and methods.

I am not prepared to discuss the relative merits of any of the common types of air conditioning equipment, or go into points of design, but rather feel qualified to describe experiences with a number of air filters applied to electrical equipment in the steel industry.

In the work I am mostly concerned with there are four air filter installations. There are also four other air conditioning systems, used in connection with turbo-generator operations, but we will hold only to air filters.

The four air filter installations represent a total maximum capacity of 400,000 cu. ft. air per minute. These filters clean the ventilating air for 31,000 HP in main drive motors and about 16,000 K.W. in M-G set capacity.

These filters are all of the non-automatic, adhesive compound type depending on impingement of air against the filtering surfaces impregnated with the adhesive compound.

We have had considerable experience with this type of filter and I am now of the opinion that it is not so much the make of equipment that will produce satisfactory operations as it is the care used in servicing the equipment.

Great care should be exercised, in the first place, in installing the equipment. Every joint, crack, and crevice must be sealed up tight; all bolt holes, conduit holes and other openings must be snug; in fact everything possible must be done to keep out every speck of dirt and make all air go through the filtering units.

A differential pressure gauge should be used as a part of each installation and the cleaning of air filters should be done according to drop in pressure through the filters. A practical condition would be one-half inch of water, or less.

I believe it is extremely bad practice to overload a filter installation and, unless other means are provided for knowing the amount of air passing through the filters, then a pressure gauge should be used in

the fan outlet to determine rate of delivery referred to a characteristic curve of the fan.

On the other hand, a bad condition will likely obtain if the velocity of air through the filters is not such that all the air will impinge on some part of the filtering media. I believe we experienced a condition for a while where 200,000 cfm in air filter capacity was used to supply a 100,000 cfm fan and the air velocity through the filters was low enough, and therefore "gentle" enough, that some air, dust laden air, got through without striking any adhesive surface. In this case, one-half the filters were blanked off by a curtain of canvas and good results obtained again.

We have recently made good use of comparators in keeping tab on condition of air going to and coming out of the filters. These, or similar devices, should be a part of every air filter installation.

Thorough cleaning of the filter units should be done even to the extent of using steam. There should also be allowed a sufficient time for draining. We have experienced some trouble with the adhesive compound coming through the filters, but we do not believe any of it ever gets through to the motors because there are so many surfaces for it to impinge upon before the air has gone far.

We have not as yet had any experience with automatically cleaned filters because the matter of labor for servicing or cleaning has never yet become an item of expense.

The 200,000 cfm installation has proven very satisfactory. It has operated over four years. The other installations are of more recent date and there is not much operating data back of them.

Points To Be Kept In Mind When Ordering Worm Gearing For Electric Overhead Traveling Cranes

A. Design

The design of the worms and gears is of the so-called high duty type using a bronze worm gear and a hardened steel worm. The gearing must be of the high accuracy type, involving ground finished on the worm and polishing of the worm wheel. Likewise anti-friction bearings have been used on all worm bearings and in the large majority of the worm wheel bearings. Provision must be made for assuring accurate adjustment of the tangencies of the pitch diameters of the worm and the worm wheel. Care must also be exercised in selecting worm drives for cranes to be assured that the thrust bearing on the worm has sufficient capacity to resist the loads imposed at the maximum torque the motor is capable of developing.

B. Rating

In the selection of a worm gear unit, for crane duty, care must also be taken to select a unit which has sufficient torque rating to compare favorably with the maximum torque rating of the motor. In other words, it is possible to consider that under conditions of acceleration, a worm rated perhaps on a basis of the continuous heat dissipating power of a motor may under such rating be overlaoded from a torque basis, and for this reason give very short life.

C.

Theoretically, after the ratio of approximately 40 to 1 is passed, a worm gear unit becomes self-locking. In applications above this ratio, great care must be exercised to secure the proper type of control to assure lowering the load of the crane if the so-called electric dynamic brake principle is used as a general scheme of controller connections. Furthermore, it is possible in the case of these self-locking loads and sluggish brake action on the part of the electric solenoid operated brake to secure a jamming action which makes it difficult to lower a heavy load. This trouble may be caused either by inadequately designed thrust bearings on the end of the worm, or by the breaking down of the oil film between the worm and the worm gear. In the few occasions that this trouble has been known to occur, operating conditions were such as to prevent a thorough investigation of the trouble. Therefore it is still uncertain whether friction between the worm and the worm wheel or jamming of a tapered type thrust bearing was responsible for this difficulty.

D.

In the design of worm gear housings for crane service great care must be used to assure a clean supply of lubricant. It is almost safe to assume that a gear housing permitting the access of the ordinary dirt prevalent around manufacturing establishments will not be satisfactory.

It is the writer's opinion that generally speaking, the use of worm gears in the United States on electric overhead traveling cranes will increase so rapidly in the next five years as to make them as prevalent as anti-friction bearings are on such apparatus at the present time.

Air Conditioning

Air conditioning as it affects the operation of electrical equipment in steel mills is of vital interest to electrical engineers who are affiliated with the iron and steel industry. This is due to the nature of the dust and fumes which are prevalent in the atmosphere about a steel mill. This dust which is abrasive and magnetic in nature clogs up the air ducts in electrical machines, resulting in higher operating temperatures, sifts into the coil slots and finally destroys or at least impairs the coil insulation. All this results in an expensive and inconvenient breakdown, and high maintenance costs.

Therefore steel mill electrical engineers are intensely interested in any device which will prolong the life or lower the maintenance costs on the important units of their equipment.

Several ideas were mentioned in one of your recent papers which I think, with a little elaboration, will be of interest to everyone.

(1) The fact was mentioned that efficiencies of 97-98% have been claimed for certain types of air filters. When buying new equipment for steel mill duty it is impossible to compare various makes of filters on the basis of their published efficiencies, due to the fact that the efficiency is based on removing 97 to 98% of the particles above a certain size, which are injurious to the health of a person.

Such a method for determining the efficiency of an air filter for ventilating a large mill motor is obviously absurd. It is quite possible that the fine microscopic particles (which are too small to count when the efficiency is determined) are carried through the filter and deposited in the machine to later cause the very trouble which the installation of the filter was to prevent.

My suggestion is that air conditioning apparatus be given a "steel mill efficiency rating" to be determined somewhat as follows:

All filters should be tested on a given quantity or weight of dust to be composed of equal volumes of, (1) dry ore dust obtained from the dust pockets of a hot gas main between the dust catcher and the gas cleaning plant and (2) dry rolling mill dust such as collects on the roof trusses of a rolling mill building. Representative samples of these dusts should be sampled and their average fineness determined and a standard set up. Air filters tested on this standard dust under similar conditions would then have efficiencies which are comparable.

(2) It was stated that filters which depend upon an oil film for removing dust from the air must inevitably be subject to a certain amount of oil entrainment. We have found from our experience that this is true in the summer time when the oil used is thin. This entrained oil is deposited on the air deflecting doors at the foundation of the machines and forms a thick gummy coating. We have also found that it is apparently impossible to wash our filter sections clean. This is demonstrated by the fact that after a year and a half of usage with regular cleaning a newly washed section is about 25 pounds heavier than a spare section which has never been used. This excess weight must be a mixture of oil and dirt which cannot be washed out, and will not drain out.

(3) Air filters with a renewable paper strainer which will remove a greater proportion of the fine steel mill dust which passes through the present filters are of interest to everyone provided the paper element is not inflammable so that it will stand sparks from dinky engines or the direct heat from a string of hot ingots. This paper element must also withstand sulphuric acid fumes which are present around blast furnaces, gas cleaning plants and coke oven plants. It will also be necessary for this filter element to operate at its rated efficiency in damp rainy weather when the incoming air is laden with moisture.

Arc Welding

In your issue of June, 1931, there is an article by Mr. Hughes and Mr. McBride.

This article illustrates the old misunderstanding that just because current flows in an arc that therefore it must be good for arc welding. The difficulty with alternating current arc is the fact that the arc is a good deal harder to maintain, requires a good deal more care on the part of the operator, and requires special electrodes. Because of this, over a period of the last thirty years, alternating current arc has been used but little and practically nowhere as a production scheme. Quite a number of people bought an alternating current for their first machine and I think in most plants you can find this first alternating current welder over in a corner somewhere collecting dust while their work is being done with the direct current arc.

Lower first cost is certainly an advantage to the alternating current transformer type machine and it is possible to figure that the efficiency is higher. It is not nearly as high as a great many people claim for it because the volts x amperes across the arc does not indicate power.

There is a power factor to the alternating current arc that is just as real as the power factor in any other circuit, and while the paper mentioned above claims efficiencies between 94 and 78, as a matter of fact no efficiency as high as this is possible in any alternating current arc. The average efficiency would probably be closer to 60% than to 90%. This is but little higher than would be obtained by the direct current motor generator set. However, efficiencies and first cost are of comparatively little moment in comparison with the other costs of doing welding. There will be spent each year of operation from two to ten times the cost of the machine in labor and nearly as much in electrode. Any scheme which will save as much as 5% in these two items would entirely over-shadow any possible saving in efficiency or first cost of the welding machine.

It is noticeable that the boosters of the alternating current arc do not give information as to the total cost of welding under variable conditions, which after all is the only thing that the purchaser of the welder is interested in.

Installation, Use and Maintenance of Fire Hydrants*

By GEO. C. PFEFFER†

Introductory Remarks

The subject of this paper—the Fire Hydrant—is one with which a great majority of you are perhaps not vitally concerned, however, it is of great importance to humanity in the prevention of loss of lives and property, therefore we must admit that every engineer should have at least a working knowledge of it.

The Fire Hydrant is the connecting link between the water in the mains and the fire fighting apparatus. Without the Hydrant, the finest equipment and most adequate water supply is of little value in protecting lives and property, therefore, the business of selecting the type and make to be used, its proper installation and maintenance is of great importance and should be the subject of thorough study and careful consideration.

A Fire Hydrant must be dependable and ready for instant use whether today or years hence. It must be capable of delivering its full capacity with a minimum loss of pressure from friction. Its construction should be so simple and rugged as to require little attention and repair during many years of service. All parts should be readily accessible for repair or replacement.

In these days of frequent traffic accidents resulting in many broken hydrants it is quite important that the hydrant be so designed as to prevent excess leakage or damage from flooding when broken and should be easily and quickly replaced without great expense.

When purchasing Fire Hydrants it is important to thoroughly investigate several makes and carefully select the best. It is necessary that they be properly installed and periodically inspected and properly maintained after installation.

The hydrant manufacturer will gladly send you instructions.

For the purpose of comparison a brief history of the development of the Fire Hydrant or "fire-plug" —as it was originally called, will be interesting.

Early water mains usually consisted of hollow tree trunks, five to ten feet long, tapered at one end to form a spigot and hollowed out at the other end to form a socket and then driven together. These wooden pipes were able to withstand only low internal pressure and their use was restricted to conveying water from the reservoirs to public fountains or cisterns from which the inhabitants obtained their supply.

For fire purposes it became the custom to dig down into the street near the fire and find the pipe. A hole was then bored in it and the water which flowed into the street was collected and used for fire fighting. After the fire was over, a wooden plug was driven into the hole in the pipe and the surface of the roadway restored.

Following the use of cast iron water mains early in the nineteenth century, higher pressures were possible. Sockets or outlets were cast in the sides of some of the pipes, which were placed at intervals in the mains. These sockets or outlets were closed by wooden plugs and a conical shield extending to the street level was placed over them. The whole arrangement was called a fire plug as shown on Fig. 1.

The shield to a great extent prevented the soil under the paving from being washed away and formed an opening to permit the plug to be withdrawn and a standpipe inserted.

To obtain water, the fireman first cleared out the rubbish which had collected in the hole, then by tapping the wooden plug he loosened it sufficiently to allow the water to force it out providing there was sufficient pressure. Where pressures were very low, the plug had to be drawn out with some difficulty by a spike on the end of the fireman's mallet. In some cases where the pressure was great, the plugs were ejected with much force and followed by a great volume of water. The job of inserting the standpipe, which is shown in Fig. 2, was extremely difficult and discomforting. These standpipes were removed after use and the wooden plug again driven in.

The use of these fire plugs was very wasteful of both water and pressure and there quickly developed a type where the standpipe was permanently driven in or attached to the mains and not removed after each use. To prevent freezing when not in use, these permanent standpipes were covered with a circular wooden housing similar in appearance to a half barrel with a hinged top. Then followed cast iron housings of the same general type and following further improvements to the standpipe, the housings disappeared altogether and the present type of post hydrant came into general use.

More than sixty years ago R. D. Wood & Co., with whom I am connected, started to manufacture the Mathews Fire Hydrant. While there has been a steady improvement in its details and the size gradually increased to meet modern demands, there has been no radical change in the fundamental or essential features of its design. The latest improvements were made within the past year, primarily to meet the modern demand for a fire hydrant which when broken off in traffic accidents will not only remain water tight and prevent damage from flooding, but which can be quickly and easily replaced without breaking up cement sidewalks, digging up the streets and interfering with traffic.

Fig. 3 shows a sectional view of a modern Mathews Hydrant. You will see that the general principle is about the same as in the old time fire

*Presented before Philadelphia Section of A. I. & S. E. E., May 20, 1931.

†Chief Electrician, Florence Pipe Foundry & Machine Company, Florence, N. J.

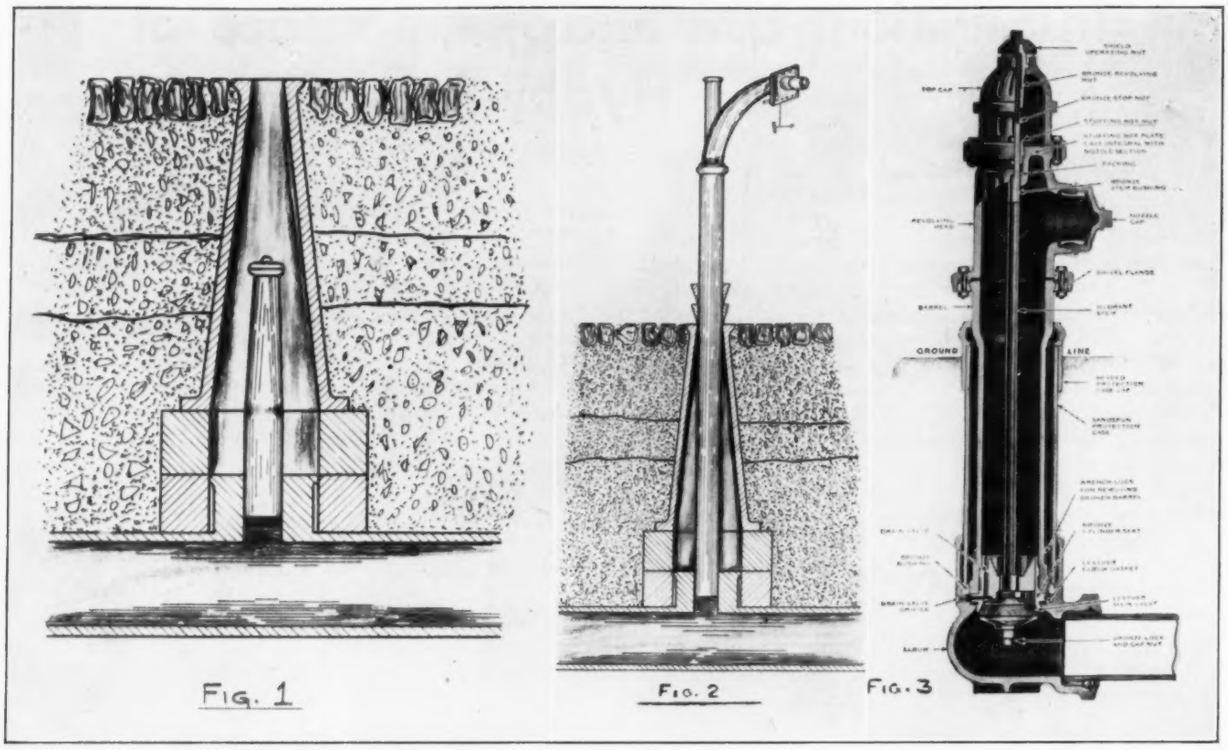


FIG. 1 FIG. 2 FIG. 3

plug. It consists mainly of three major parts—the standpipe or barrel, complete with all its working parts which compares with the old timer except that instead of being driven directly into the main it screws into its own elbow and is easily and quickly removable for repair or replacement. The elbow is connected to the end of a short branch pipe running from the main pipe line. Modern practice is to place a gate valve on this branch line so in case of accident or necessary repair the hydrant may be isolated from the rest of the system.

The protection case may be compared with the old time conical shield, but in this case it is free to move vertically and independent of the barrel of the hydrant, so as to prevent damage from frost upheaval and to permit the removal of the entire barrel.

All our fire hydrants are equipped with a main control valve and an automatic drain valve. The main valve is of the compression type opening against the water pressure and closing with the water pressure. It is built up of several layers of oak tanned sole leather and rigidly held between the upper and lower valve plates. The whole arrangement shaped so as to prevent excessive loss of pressure through friction.

The drain valve is cast integral with the upper main valve plate. It is faced with leather and operates inside a smooth brass cylinder. The main valve and waste valve are a unit and securely fastened to the hydrant stem, therefore, when the hydrant is opened the drain valve follows the main valve downward and seals the drain orifice. When the hydrant is closed of course both main and drain valves travel upward together. The main valve closes the hydrant and at the same time the drain valve opens, permitting all water which is left in the standpipe, to drain out. The development of the drain valve eliminated the necessity for the old time covers to prevent freezing.

The hydrant is operated by means of a special hydrant wrench which is fitted to the operating nut at the top.

The operating thread is located in the top of the hydrant and is sealed from the water passing through the hydrant by the stuffing box so that it is protected against corrosion.

This is the only part of the hydrant which requires occasional oiling. It is oiled through the oil hole located in the top of the operating nut.

Below the hose nozzles or outlets a specially designed swivel flange is located, which permits facing of the nozzles in any desired direction by simply loosening the bolts.

For factory service it is usual to equip all hose outlets with independent cut-off or control valves as shown in Fig. 4. This permits the independent control of the several streams.

Fig. 5 shows a Modernized Barrel or standpipe complete with all its parts.

Four heavy lugs are cast on the outside of the barrel at the base. In the event of a broken hydrant, a tubular wrench (Fig. 6) is slipped down over the barrel, engaging these lugs, makes it easy to unscrew the broken lower section of the barrel for replacement, without digging or breaking the pavement.

When the hydrant is not in use the nozzle threads are protected by nozzle caps. These threads should be periodically greased so they may be quickly and easily removed in case of fire.

In closing let me add that, amazing as it may seem, the most neglected hydrants are those in private plants, just where the contrary would be expected.

When you go back to your respective plants to-

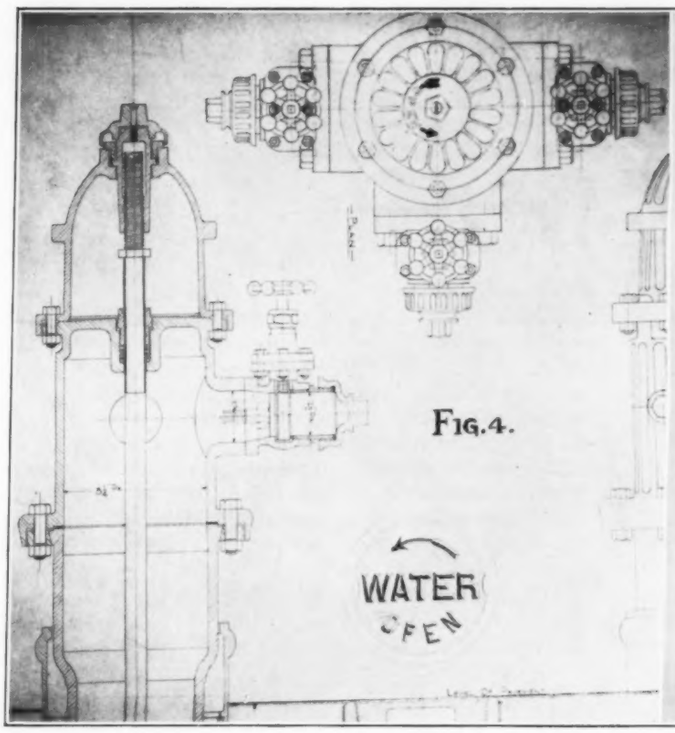


FIG. 4.

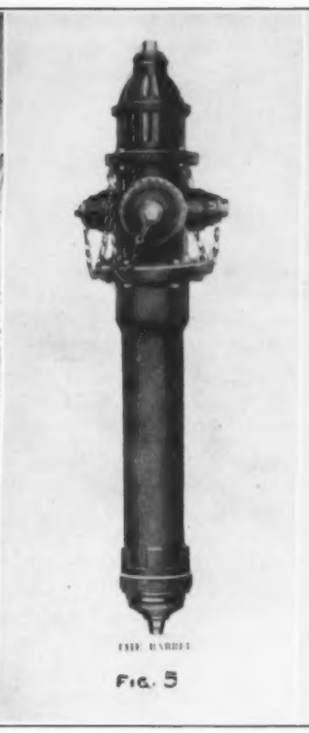


FIG. 5

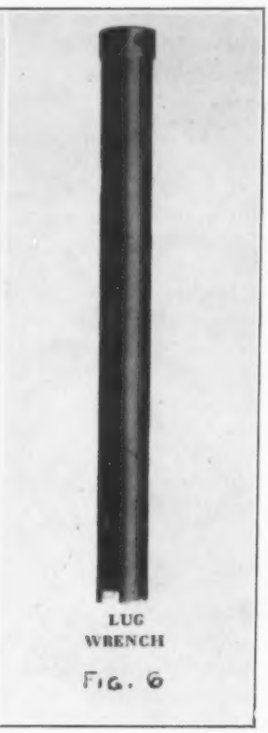


FIG. 6

morrow, make it a point to look around and ascertain how many fire hydrants you are depending on for fire protection. Find out if you have a competent man whose duty it is to regularly inspect and maintain them and make sure he is thoroughly familiar with the hydrants in use and that he gives them proper attention. If he is not familiar with them, get him to write to the manufacturer for a description and instructions how to take care of them.

Hydrants should be inspected at least once each Fall to see that they operate and drain properly, so that they won't freeze during the winter and at the same time, they should be greased and oiled.

You certainly would not neglect your electrical equipment or other machinery about the plant—give your fire hydrants a chance. Their proper condition is of vital importance to the safety of the plant.

Discussion

K. M. Raynor*: Are there any questions to be asked in connection with the Fire Hydrant?

Question: Is it customary to have a Valve before each Hydrant?

A. F. Pleibel†: The hydrant is usually set off from the main itself and has this auxiliary gate valve. It is very desirable to have it because if anything happens to your hydrant, the repair man can shut off the water by using the Gate Valve. I strongly recommend the Gate Valve.

Question: Is there a standard for the hose attachment?

A. F. Pleibel: No universal standard, but the tendency is toward standardization.

Question: I am a member of a suburban fire company. There are several placed where we have to hunt around for some special wrench, and I was wondering why that should not be standardized.

A. F. Pleibel: The tendency is toward standardization. When we ship a fire hydrant, if nothing is mentioned regarding the size of the operating nut, we will ship it a five-sided nut. In Philadelphia they use a three-sided nut. There is no standard for the entire United States. As far as the thread is concerned, the tendency is to make it 2½" inside diameter, 7½ threads per inch. In New York City their standard is 2½" inside diameter, 8 threads to the inch. It is the same with Cleveland. It is very difficult to get towns and cities to change to accommodate the Fire Underwriters because of the expense involved.

Question: Do you know whether the suburban sections around Philadelphia have the same standards as Philadelphia?

A. F. Pleibel: No, I cannot answer that. I do not know, but the tendency is for the outlying districts to adopt the standard of the neighbor on whom they are going to call for assistance in case of fire. So that your neighboring communities here, if they frequently call on Philadelphia for assistance, they undoubtedly have the Philadelphia standard, or are usually equipped with adapters and can make a hookup readily.

Question: What consideration is given on the water side to take care of the sediment?

* Electrical Supt., Lehigh Plant, Bethlehem Steel Co., Bethlehem, Pa.

† Sales Manager, Florence Pipe Foundry & Machine Co., Florence, N. J.

W. Price:** The first accumulation of sediment will be in the elbow.

Question: How often should the hydrant be washed out?

A. F. Pleibel: I should say twice a year it should be flushed to see if it functions properly and to see that it drains properly.

Question: Did you ever hear of any leather valves sticking?

A. F. Pleibel: No, I have not. There are some Fire Hydrants that have rubber valves against a bronze seat and sometimes that rubber will stick, but I do not know any case where the leather has given such trouble.

Question: What is the matter with making a fire hydrant that is flush with the ground?

A. F. Pleibel: We do make flush hydrants, but the trouble is you will have difficulty in locating them in the winter time when the snow is on the streets. They are used in tropical countries where they do not have snow or freezing to contend with. We do make the flush or tropical hydrant.

Question: In regard to this inspection you speak of; how do you know if it is drained properly?

A. F. Pleibel: You can tell if it is draining by placing your hand over the nozzle. If it is draining a vacuum is created.

Question: Going back to the question of standards. Does the manufacturer of hydrants attempt to be the guide in this matter?

A. F. Pleibel: Yes. If in a new community, they will not stipulate what they want, the National Standard will be recommended by the manufacturer.

Question: This suburban fire company, or country club, have had these hydrants in for the past five or six years, and the hose does not fit the nozzle.

A. F. Pleibel: That is not serious. A few dollars will take care of that difficulty. Put a new nozzle there with a different thread on it.

Question: What is the high pressure in Philadelphia designed for—300 pounds working pressure?

A. F. Pleibel: When you get above 200 pounds you are talking high pressure. Philadelphia has two pressures: In the outlying districts low pressure, and in the center of the city high pressure.

In talking high pressure, we build the same general design of fire hydrant, but equip it with a relief valve. This will operate so that the pressure is equalized on both sides of the valve, facilitating the opening of the valve.

Question: Is the business section protected with the high pressure system, and are there many hydrants broken by automobiles?

A. F. Pleibel: Yes. The breaking of fire hydrants by automobiles is a serious matter. In New York City, I believe, they have over 1,000 fire hydrants broken every year. Philadelphia will have about 600. It is a very costly item in the maintenance of fire hydrants.

** Florence Pipe Foundry & Machine Co., Florence, N. J.

"Controlled Conditions" Plant †

By H. E. STITT*

To get the proper understanding of the subject assigned me, namely, "Controlled Conditions Plants"

H. E. STITT

it will be decidedly helpful for you to avoid any confusion between Controlled Conditions and Air Conditioning. The science of Air Conditioning has to do solely with treatment of the air and is but one of the factors utilized in accomplishing Controlled Conditions. On the other hand, Controlled Conditions is an extremely broad and inclusive subject. The question what, in short, is Controlled Conditions may be properly asked here. Probably the best answer and description is that it is a new economic method—in short an attractive road and means to better products and greatly increased profits. By means of it the manufacturer controls his production in the same way as the captain on the bridge of a transatlantic liner controls his ship. Most production management, today, is too remote.

Instead of describing Controlled Conditions in an abstract way it will be better to illustrate an application of it by briefly reviewing the new Simonds Industries Plant designed and now being constructed by our company at Fitchburg, Mass. However, it should be remembered that the engineering features of that particular Controlled Conditions plant are not of the greatest concern, but the important point is the idea that they represent. Similarly, where figures are quoted to illustrate the method of Controlled Conditions, importance should be attached to their economic significance rather than to the particular figures used.

It is not often that a conservative company like

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* Chief Engineer, The Austin Company, Cleveland, Ohio.

the Simonds Industries makes such a radical departure from usual procedure and on so large a scale as their present building operation. What influenced the owners to decide as they did and will it pay? Before going into the questions of how production per man hour will be accelerated in the new plant, we may possibly first consider the fundamentals of a manufacturing proposition which as much as anything else probably influenced this installation. The length of working day for men is decreasing, and our present over-supply of workers may mean that the working day will continue to grow shorter year by year. On the other hand, why should not the factory buildings and machines work two, three, or even four shifts? Overhead cost due to first cost of buildings on an average may run about 15% of the cost of production. Divide this by two, three, or four (if you have extra shifts) and there is an appreciable saving in lessened overhead. The cost of manufacturing machinery may be two-thirds of the cost of the buildings, and the interest, depreciation, and especially the amortization of machinery may run very much higher than for buildings. Wear out, rather than rust out, is fully as good for machines as it is for men. Insurance covers risks for 24 hours a day at the same cost as for one 8 hour shift. So why not have the plant buildings and tools work overtime? There has been a strong feeling against working nights—probably as much from capital as from labor—because the night shift was not a money maker. Poor light made for lower production, more wastage and more accidents. Better lighting has corrected this and the logical step economically is shorter hours with increased efficiency for men and longer hours for buildings and machinery.

This building without windows is not the result of wishing to be different, but is the outcome of years of thought and experimentation which convinced the owners that the results would warrant a new departure. Conditions governing the saw business have changed since they started in business 99 years ago to make saws for the lumber industry. Lumber is rapidly disappearing—substitutes are taking its place—and old established fields are therefore on the decline. Faced with an alternative of either liquidating, accepting a declining market or stepping forward into new fields, the latter was the decision and in doing so the object was not only to bring manufacturing up-to-date but to place it years ahead of its time.

This concern is now and have for a long time been making saws for all the substitutes that are replacing wood, in addition to hacksaws, metal and stone saws and indeed all kinds of abrasive cutting sheets, etc. But this work is being done in three plants—one in Chicago and two in Fitchburg. These three plants have a combined floor area of 600,000 sq. ft. and are operated with average economy. Their artificial lighting intensity is 4 to 6 ft. candles which is probably as good as the average plant. For years the owners have thought and experimented more than most companies and now have first hand information as to the values of First, better lighting; Second, better ventilation; Third, control of heating and humidity; and Fourth, the advantages of sound control and the influence of color and music—in other words, "controlled conditions."

First: To get the maximum production effect from good light, they feel it is necessary to prevent large or quick changes in light intensity and to be able to get this maximum light for 24 hours at a time. This requires the use of artificial light for at least part of the day and the savings of using daylight part time must be balanced against the cost of window construction and cleaning together with heat losses through the glass in the winter period. They decided on a light intensity at the working plane of 20 foot candles and from this better lighting plus better comfort conditions the owners expect to get 20% increased production.

Second: No windows to open means artificial ventilation and this is also figured as an additional help to increased production. Clean washed air with the proper humidity will add greatly to the comfort of the workers both summer and winter. It will decrease sickness and labor turnover losses which constitute an appreciable percent of overhead. Due to the processes required in their work as well as the heat thrown off by lamps and motors, there is an excess of heat which has to be removed from the building and as this is done by dilution with cooler air, there are large quantities of air to be moved. Even in the winter time it is probable there will be an excess of heat in the building which may have to be wasted. The capacity of the ventilation equipment (handling 500,000 cu. ft of air every ten minutes) is such that there is a guaranteed maximum temperature of not more than 16° F. above the outside wet bulb temperature during the summer months. This will insure a maximum 60% relative humidity which is within the comfort zone and in general maintain a temperature of from 5° to 10° below the outside temperature during extremely hot weather. No system involving refrigeration, at present, is contemplated. The ventilation ducts will be carried through the trusses and partial recirculation will be employed during the winter. All fumes, exhaust gases or odors are to be cared for at the points of origin and exhausted to ducts under the floor.

Third: Uniform heating is required. The presence of cold areas and drafts from windows avoided. Doors are few and will be kept closed except when absolutely necessary to be open. Doors are without glass, and jambs are designed to prevent air leakage. The temperature of the plant is to be 68° maintained from 30" above floor to 6'-0" above floor. This uniformity of heating with proper humidity will add to the comfort and health of the workers. Also it has been found that all sharp tools, and instruments manufactured in air of uniform temperature, and proper humidity have better cutting edges than they otherwise would and Simonds uses a silver screen for a background to more easily and quickly detect imperfections in cutting edges. This percentage of improvement is valuable in assuring a better product and less wastage to the Simonds Industries.

Fourth: The matter of sound control, particularly in a plant manufacturing steel products, is of the utmost importance. Straight line operation without back-tracking is very important for large production and this prevents the removal of noisy or fume making departments from their straight line position. Drop hammer work, filing, grinding, forging, etc. with their usual noise and vibration is to be handled in the main building without separating partitions and all machines doing such work are to have insulation joints and cork padding under their foundations.

Process manufacture emitting noise of high frequency will be dampened in the truss structure at certain points and a system of vertical baffles will be used to assist in breaking up and deflecting sound waves to the sound absorbing roof above. Wherever a machine has an exhaust creating noise, this will be muffled through a silencer of the Maxim type. Walls, roof, and floor are all to be sound absorbing. The floor will have a concrete base with an acoustical wood block for such portions not occupied with equipment foundations. The Therma-Koustic roof is of particular interest. It is of a solid, metal acoustical type of high efficiency. The first layer is a structurally strong perforated roof deck to permit the passage of sound. Above this is a layer of rock fiber bound in asphalt and on top of this is a layer of heat insulating board and the built-up waterproofing. Thus in addition to sound absorption qualities, the roof has insulating qualities as well, keeping out heat in summer and retaining heat in winter. The walls of the building are of accoustical cinder block faced outside with brick for architectural effect. The architectural treatment is along the advanced German modernistic trend with well defined horizontal lines to produce a pleasing and dignified appearance.

It is expected that the building will absorb about 93% of the usual noises and workmen near large machines will be able to converse in ordinary tones. Due to the accoustical arrangements it will be possible to locate the plant office at one unpartitioned end of the building. It is expected that the lessened noise will greatly decrease the nervous tension and distractions usual to the modern factory din, and that accidents and fatigue of workers will be materially lessened. Instead of the noise conditions existing in most plants of this kind, which by audiometer test would register 90 to 100 decibels, the noise in the new plant will be reduced to approximately 60 decibels. In intensities, this difference would be the ratio of one billion units for 90 decibels to one million units for 60 decibels. Usual conversation is about 40 to 70 decibels and heavy city traffic will register up to 80 decibels.

The plant will also embody the latest results of psychological research into the effects of color in depressing or energizing human beings. It is well known that certain colors produce certain effects on the mind and certain nervous reactions. Some are stimulating while others have a sedative effect. Colors for the building interior have been selected with a view of attaining the best possible reaction from workmen, tending to keep them in a cheerful and active frame of mind while employed. The color scheme of the interior is for a blend of blue, green, and white for walls and ceiling. The blue will reflect certain ultra-violet rays from the lamps. Green is the active or energizing component, while white is for the sensation of light and to reflect cleanliness. The company will initiate orange as the color for machines. This color was selected because it will lift the visibility of machine parts and aid in accident prevention. The machinery layout of the plant is planned to reduce industrial fatigue to a minimum. Unnecessary motions will be eliminated from all operations and physical effort of the workmen will be reduced as much as possible. Bench work will be done away with as a usual thing—but where used, benches will be adjustable for maximum efficiency.

Consistent with the desire to eliminate noise and abstraction, this plant also will have a system of radio call-boxes which will be used for special announcements and for music during those periods of the day of greatest fatigue. Considerable study was made of the effects of music on employees and it has been found that under conditions of fatigue after many hours of work music actually raises the percentage of efficiency and production as much as 1½% instead of dropping as usually happens at such times. It is difficult to estimate the decrease in efficiency due to noise, but if music during a short period of time will actually increase production 1½%, instead of falling off, surely cutting the factory noises from 90 to 60 decibels for the full time of the working period should make a large increase in production. In our own shops where welding has largely superseded riveting with its attendant noise, the ability to speak normally and to hear ordinary conversation with clearness has certainly benefitted our shop production besides lessening the chance of accidents. No recreational facilities are provided, as the owner believes the worker prefers to get his recreation elsewhere than where he works. There are no shower baths in the building, but toilet rooms, wash rooms, and rest rooms are as finely fitted up as they are in large office buildings. Lunch rooms for tea, coffee, and a few minor food products only are provided, but refreshments will be served to employees at their stations in the plant at the midday period.

The owner will do away with card and accounting systems and largely depend on supervision from the overhead observation walkways. At the start the owner expects to use two shifts of 350 employees each and work for eight hours althought they expect to soon reduce the number of hours per shift. The hours now considered are from 7 a. m. to 3 p. m. and from 3 to 11 p. m. This gives both shifts practically equal opportunity to enjoy daylight pursuits and sports outside of working hours and to obtain a normal sleep in the night period. A third and a fourth period, if of shorter hours each, would also probably be unobjectionable to the workers. This will be touched on again later.

The size of the building is predicated on the two shift idea and as a result is only one half the size it must otherwise have been. The building which is located on a 54 acre tract is 360′x560′ with four service and fan houses 30′x60′ on the exterior of the main building. The building is designed so that it may be enlarged on all four sides, in which event the fan houses will be elevated into the trusses above their present location. Columns are spaced 40′x70′ apart and bottom chords of all trusses are 18′ from the floor and the trusses themselves about 8′ high. These trusses are all welded rather than riveted and are stronger and very much stiffer than riveted trusses, besides being lighter. Felt is used between the ends of the trusses and the wall columns to cut down vibration from trusses to outside walls. The steel is also designed to allow the future addition of monitors for light, if changes should be advisable. At present the roof is flat. There are no sprinklers in the building except for the department where wood working and carpentry work is done. There are no partitions anywhere in the main building so there is a free and unobstructed

view in every direction from the observation platforms or cat walks as they are called.

A stand-by storage battery lighting system is provided which will go on in case of interruption of the main current. This secondary lighting service gives only enough light for safety purposes and not for working. Before passing to the economic phase of this installation it might be well to again refer to the lighting system which has finally been adopted. At first, 1000 watt Mazda lamps spaced to give about 20 foot candles on the working plane from a lamp level 18 feet above the floor was contemplated. Next a white light Neon installation was contemplated. This was to be made up of a red center light and two parallel green lights. The tubes were to be spaced 20′ by 17′-6″ and would give 18 foot candles without glare. The light from these lamps was very good but first cost and cost of upkeep were both high although the power consumption was low, about 550 W. per fixture. The final decision was for a combination of a rectangular fixture made up of an outside "U" shaped mercury vapor lamp with four, 75 W. Mazda lamps in a line inside to loop of the "U." The result is a white light without glare and which has all the advantages of the usual mercury vapor lamp as regards freedom from deep shadow, etc. This lamp takes 650 watts and gives about 20 foot-candles. The owner likes the light from the mercury vapor lamp but would not consider it due to their studies regarding colors.

Simply as an example indicating possible savings, let us now consider the savings in operating cost which an owner expects to make and which will be an answer to our starting question "Will it pay?" Assuming wages at 80c per hour and the total number of employees at 700 divided into two shifts of 8 hours each—the total yearly wages of the plant based on a 300 day year is $1,344,000.00. Increasing the lighting intensity from 5 foot candles to 20 foot candles is assumed to increase production about 10%. From proper heating, ventilating air, washing, noise prevention and proper interior painting, the owner expects to gain another 10%. If these expectations are realized, there will be savings due to better lighting and better comfort conditions equal to 20% of the total wages paid. In addition to the savings from better light and better comfort conditions, there are pronounced savings due to combining three plants with 600,000 square feet of manufacturing space into one building of only 208,800 square feet. Cutting overhead of three separate factories to that required for one, and introducing straight line production in that one will cut cost of production and a saving of 13% is allowed for these economies. Twenty per cent from light and increased comfort, plus 13% for factory combination and straight line production gives 33% increase in production and makes a saving of 33% of the total yearly payroll. This amounts to $443,520.00. There is a saving in fuel and boiler firing labor due to decreased window and roof radiation losses equal to $5,000.00 but there is a counter charge of $55,300 to cover the cost of additional light and power required for lighting and ventilating the windowless building for two shifts. Power needs cause a reduction of $50,300.00 from the profits due to the economies mentioned, giving a savings from all cause except investment charges equal to $393,220.00.

To get capital charges we will compare the cost of a windowless, two shift building with a window building of twice the area. Cost of a "Controlled Conditions" building without the machinery is about $1,000,000.00. Cost of equivalent one shift building (twice as large) without its machinery is about $1,400,000.00.

Assuming 13% for interest, taxes, depreciation and amortization on this difference in cost gives an overhead yearly saving on building capital of $50,000.00. In addition to this there is a large capital saving on the machinery.

Mr. Blackburn, formerly with Oakland Motor Company states that machine tool obsolescence, on the average, is today greater than machine tool depreciation. For automobile business, he suggests the 10% standard government allowance for depreciation on equipment plus 10, 15, 25 or 50% for obsolescence. In electric work Mr. R. H. Rogers, General Electric Company says, any motor or control over five years old should be coldly scrutinized. Gorton James, Editor of Business Week, says rate of obsolescence on airplanes is 33-1/3% to 50% yearly and the rate on the machines that make them is low at 10% to 20%.

With a machinery cost for the window building taken at $900,000.00 and for the two shift building at $500,000.00 and assuming 8% interest and taxes plus 20% for combined depreciation and obsolescence, the yearly saving on the machinery in the two shift building amounts to 28% times $40,000.00 equals $112,000.00.

Savings per year from all sources based on an hourly basis of 80c per hour amounts to $555,220.00

And on a basis of 60c labor the savings would amount to $494,500.00.

Simonds Industries: A prospering company, 99 years old. A unique organization of New Englanders balanced in brain types to produce the best results. One, a man of enthusiasm fertile in ideas; and another to weigh and balance those ideas; a statistician to chart the course and an outside consulting engineer for the outside viewpoint.

What influenced the owners in their decision for a new plant in a windowless building?

Shortening work day hours and possibility of increasing number of shifts per day. Overhead expense—interest, taxes, insurance—same for 24 hours a day as for 8 hours. Overhead expense—depreciation, amortization and obsolescence—less, due to smaller plant and more intensive use of equipment. Increased production—10% from more uniform light of more than triple intensity, 10% from better health and better comfort conditions (heating, air conditioning, sound control, cold psychology, music, etc.) and 13% from straight line production plus economies of combining three plants into one $393,220.00
Lessened overhead 162,000.00

Total annual savings on basis of 80c labor $555,220.00

This will pay for the new plant in three years.

The building—360′x560′ or roughly 5 acres no inside partitions, large column spacing 70′x40′-18′ under the trusses. Walkways for group supervision above the working plane. This arrangement will eliminate elaborate cost accounting and nip produc-

tion losses in the bud instead of holding post mortems periodically as is so commonly the case at present.

"Controlled Conditions" have been inevitable. The advent of straight line and mass production and the gradual improvement in manufacturing facilities and conditions, especially in the United States, make "Controlled Conditions" the next logical step.

Artificial conditions or man-made weather are not new in industry. Many products have required humidity control for the better handling of the product or the materials from which the product was made. As an example we might mention such industries as textile, printing, tobacco, candy and other food industries. Proper humidity in a textile plant prevents the threads from breaking; in a printing plant it makes accurate registration for successive impressions possible; in the tobacco industry it prevents the tobacco leaves from breaking; and in the candy industry it facilitates the drying and handling of the candy.

Artificial lightning, even in the daytime, is not new. Noise control, however, is rather new, especially in industry. It is significant, however, that in the Simonds Industries "Controlled Conditions Plant" all of the conditions are being controlled in a large, important way. To the best of our knowledge, this is the first time this has been done on a large scale. It is further significant that it is being done in an industry whose product primarily does not require "Controlled Conditions" for the sake of the product itself. In short, "Controlled Conditions" are being introduced into industry for the sake primarily of the increased profits through the worker.

To get the proper realization of how far "Controlled Conditions" have advanced, we have but to realize that they are now being introduced primarily for the sake of the employee's comfort, so that he may produce more and increase profits. While we are all familiar with artificially controlled weather in theaters, hotels, restaurants, and other buildings where people congregate for amusement, entertainment and other social gatherings, the introduction of artificial weather in the Simonds plant is the first real practical application in industry so that greater profits might be produced through the influence that "Controlled Conditions" would have on the worker rather than on the product.

Other "Controlled Conditions" plans we might mention are Mars, Incorporated, designed and constructed by our company in Chicago, and the General Electric Company's new wire filament plant which we are now constructing in greater Cleveland. General Electric Company's wire filament plant will have adequate artificial lighting for a windowless plant but will have natural ventilation through sash principally in the monitors.

From the roster of your Association of Iron and Steel Electrical Engineers I note that naturally most of your members are engaged in the steel industry which, because of its product, requires continuous operation throughout the 24 hours in many departments. It may be difficult for you to appreciate the problems which arise in the manufacturing industry generally, and especially in industries where continuous operation is not required by the nature of the product. For instance, in a manufacturing plant which ordinarily operates one daylight shift, it is difficult to appreciate how inefficient much of the night operation has been. This is because the night shift is often a make-shift and is poorly manned and poorly supervised. It frequently is used as a necessity to relieve bottle-necks in the daytime operation.

Generally speaking the industries which operate continuously have a relatively small ratio of annual sales to capital invested. This applies to such industries as the steel, cement, fertilizer, glass and ceramics industries. In general manufacturing industries, particularly those industries which are assembling products such as automobiles, etc., the ratio of the annual sales to capital invested has been relatively large; in fact, several times that of the industries mentioned above. Many industries have been forced into continuous production in order to make adequate profits from the capital invested rather than from the nature of the product requiring continuous operation. The growing elaboration of plants in general is making this situation increasingly prevalent.

"Controlled Conditions" are most flexible and may be employed in buildings with or without windows and with or without multiple shifts. Every plant in every industry should be carefully analyzed and only the controlled conditions which can be advantageously applied, should be introduced. In short, "Controlled Conditions" offers the manufacturer the most versatile and productive means of overcoming his problems and for accomplishing maximum profits.

Who Will Benefit From Multi-Shift Buildings?

By C. G. PALMER*

The smaller, multi-shift plant is not an unmixed blessing, especially to the building constructor. What will result if it becomes general practice for manufacturing plants to operate two, three, or more shifts per day? And what will be the result if these half size buildings are windowless? Of course the owners of these smaller buildings save money on overhead costs and operating expenses, but will they lose it again on decreased future business? A great many people get their direct living from new construction and they are only a small per cent of those who will be indirectly affected by lessened materials to be produced and used. Quantities of brick, cement, steel, roof lumber and waterproofing used, will decrease very noticeably. The effect on sash, glass and putty manufacturers will be especially severe. Heating plant equipment will be cut at least in half even though windowless buildings do not make the savings in manufacture anticipated, but the cut will be still greater if windows are omitted. With manufacturers of electrical and ventilating equipment there is another angle and as far as lighting equipment is concerned the results are mostly favorable. True, the buildings will be smaller but when the plant is designed for at least one regular shift with artificial light, even conservative owners will want

*Research Engineer, The Austin Co., Cleveland, Ohio.

greater light intensities than they would if the artificial lighting were only a stand-by. This means more and larger lighting units and if the intensities advocated are reached or approximated, increased electric current consumption is going to add enormously to the requirements of public and private lighting utilities. The reduction in size of buildings, spreading both lighting and power consumption over two or more shifts, will flatten the power curve of power utility companies with accompanying economies to these companies. Their prosperity will tend toward earlier replacement orders for equipment. Lamp renewals should increase greatly.

Ventilating equipment makers should thrive. In the windowless building, artificial ventilation is indispensable and even in a window type building it is expected that the increased business profits due to the comfort and health induced by clean washed air will do away with ventilating sash and require mechanical ventilating equipment. This should more than offset the ventilating equipment which would normally be provided for the occasional building of single shift size. The power units required to run the ventilating equipment will partially offset the loss of about half the number of machine power units. These omitted units will not be needed due to double time service of the other half. And, of course, this smaller number of machine units does not entirely represent lessened buying, as normal wear is in proportion to the time operating.

On the whole, the electrical equipment manufacturers are probably the ones to get the greatest benefit from the change to multi-shift buildings, either with or without windows.

Recent Developments In Sheet Mills

(Continued From Page III)

hundred degrees were not unusual. Recent developments in sheet mill furnace designs and construction have been taking place so rapidly, due to mechanization and electrification of equipment, that present practices do not bear out the statement, which appeared in a recent edition of a recognized book on mill practices, that proper temperature of pairs in a furnace "must be determined by the eye, as pyrometers are useless for this work."

Returning again to the actual mill operation, the bars are stacked and taken to the charging floor at the rear of the continuous pack heating furnace after they have been rolled, matched and again rolled to the thickness at which they may be rolled in the finishing mill. The charging process and operation of the continuous pack heating furnace is practically the same as previously described for the continuous pair heating furnace. In the case of double width furnaces, one side is usually used for roughed sheet packs and the other side is operated with packs which have been partially finished, matched and doubled and returned for reheating prior to finishing.

With the packs now ready for finishing, the roller operates a master switch similar to that used with the pair furnace. A pack is delivered from the continuous pack heating furnace, as were the pairs of bars from the pair furnace, to a conveyor which delivers the pack to a mechanical feeder, which is also called a rollers table. The roller places the master in the "automatic" position and the conveyor begins traveling in the direction of the mill. After squaring, the pack is carried through the mill to a mechanical catcher which is similar to the mechanical feeder. After pack clears the mill, the mechanical catcher tilts and the conveyor reverses, carrying the pack over the top roll to the mechanical feeder which has also elevated. Both mechanical feeder and catcher tables drop as the pack clears the rolls and the conveyors again automatically reverse to repeat the cycle until the pack is finished to the proper length. At this time the master is changed to the "runoff" position and the mechanical catcher table, instead of elevating, continues to carry the pack either to another conveyor which carries it to the shear, or to a catcher who drags it over the cooling floor to the shear.

The rapidly increasing number of installations of these modern equipments during this critical economic period emphasizes the trend toward the betterment of product and reduction in production costs. On some of these recent installations, the production, per stand, has already been doubled; this figure, of course, may vary with the type of sheet rolled, but is a fairly accurate average. While it is too early to have specific figures, it is a fact that in some plants scrap loss has been reduced and when the operators become more familiar with the operations, this loss will, no doubt, be further reduced. Savings in production costs up to $5.00 per ton have already been effected and, in addition, it is expected to materially increase the quality of the product. In fact, cold rolling of some classes of finished sheets may eventually be eliminated.

One of the interesting electrical developments in this field is the rapid operation of these mechanical feeder and catcher tables. Only two years ago, forty reversals per minute was considered impossible. To day this has been accomplished and higher speeds may be expected as the operators become more familiar with the automatic equipment and further improvements are made in rolling methods.

ITEMS OF INTEREST

PERSONNEL CHANGES

Ralph N. Robertson, formerly with the Blaw-Knox Company in the capacity of Chief Mechanical Engineer, has accepted a position with the Atwood-Bradshaw Company, at Pittsburgh, Pa.

Louis J. Boyer, formerly with the Newton Steel Company, has resigned to accept a position with the N. G. Taylor Company, Cumberland, Maryland, a subsidiary of the Corrigan-McKinney Steel Company, Cleveland, Ohio.

Alfred E. Waller, formerly Chief Engineer of the Ward Leonard Company, Mt. Vernon, New York and recently in an executive position with the General Cables Corporation at New York, has become affiliated with The Clark Controller Company's organization and will make his official headquarters at the Sundh Electric Company's plant at Newark, N. J. Mr. Waller's many friends will be pleased to learn of his new connection.

Mr. Surendra Nath Bose, formerly Deputy Chief Electrical Engineer, has been promoted to Chief Electrical Engineer of the Tata Iron & Steel Company, Ltd., Jamshedpur, India. Mr. Bose is an Active Member of the Association of Iron & Steel Electrical Engineers and has presented a number of valuable contributions to the Transactions of the Association.

Chatard and Norris, 218 Water Street, Baltimore, Md., have been appointed exclusive representatives of The Homestead Valve Mfg. Company for the eastern part of Maryland and District of Columbia.

Ralph Leavenworth has been appointed general advertising manager of the Westinghouse Electric and Manufacturing Company, according to an announcement made by J. S. Tritle, vice-president and general manager. He will have charge of all advertising and publicity activities of the company, including the advertising division of the merchandising department, now centered in Mansfield, Ohio.

George E. Tutton, formerly with the Jones & Laughlin Steel Corporation, has resigned to become head of the tin plate sales of the Republic Steel Corporation at Youngstown, Ohio.

Dr. George B. Karelitz, formerly manager, mechanical division of the Research Laboratory Westinghouse Electric and Manufacturing Company has accepted a position as engineer in charge of transportation at the South Philadelphia Works of the Westinghouse Company.

Dr. M. A. Grossman, formerly vice-president and director Republic Research Corporation, has resigned to accept a position with the Illinois Steel Company, Chicago, Ill.

W. L. Mellon has been elected a member of the executive committee of the Westinghouse Electric and Manufacturing Company. He succeeds the late Harrison Nesbit.

A. A. Probeck has been appointed sales manager of the Federal Machine Company, Warren, Ohio.

H. W. Kilkenny, formerly with the Ohio Brass Company, has opened an office in Cleveland, Ohio. He will represent the Central Tube Company of Pittsburgh and the Moloney Electric Company of St. Louis.

L. W. Erickson has been appointed district representative Foote Bros. Gear & Machine Company of Milwaukee and Wisconsin territory.

Sibbald Reid has been appointed assistant district manager of the Pittsburgh office of the American Rolling Mill Company.

WITH THE MANUFACTURERS

Allis Chalmers Manufacturing Company of Milwaukee, Wisconsin are distributing their Bulletin 3012 on "No Load Tap Changers for Power Transformers for operation from the Side of the Case." This bulletin many be secured by writing the above concern.

The General Electric Company of Schenectady, N. Y. have prepared a very attractive 24 page booklet on Electric Furnaces. The booklet contains many curves and photographs of installations and is now ready for distribution. Copies may be obtained by writing for Bulletin GEA 1146-A.

A New Series of High Speed Gear Units

The Buffalo Division of the Farrel-Birmingham Company announces a new development in high speed gear units which are suitable for increasing the speed of the driven unit as well as reducing speed. This unit is especially adapted for connecting Diesel or Gas Engines to high speed Centrifugal Pumps and similar service. These gear units are suitable for speeds up to 6,000 R.P.M. and will operate from 120 H.P. to 2,500 H.P. with ratios up to 10 to 1 for either increasing or reducing speed. A complete lubrication system is provided together with an oil cooler consisting of a coil of copper pipe placed in the bottom of the gear case.

The unit is provided with forced lubrication for all bearings and spray lubrication for the gear teeth. The gears are not allowed to run in a bath of oil and consequently, the excessive generation of heat is avoided.

The mechanical efficiency of the gear units is

Driving a rock crusher, this **ELLIOTT Synchronous Motor** starts the load jamfull of rock . . . and without excessive starting kv.-a.

A tough job for any drive—but the kind of job where the Elliott Synchronous Motor, designed from the ground up to meet the need, shows its value to the full.

The properly designed synchronous motor is an excellent performer. It has exceptionally high efficiency, high torque characteristics, rugged dependability, low starting current needs, and a favorable effect on power factor.

Assign the husky jobs to husky Elliott Motors.

ELLIOTT 150-hp., 300-r.p.m. SYNCHRONOUS MOTOR built for a limestone company to drive a gyratory crusher. The motor is totally enclosed on account of the rock-dust laden atmosphere. Anti-friction bearings assure maximum mechanical efficiency. This motor was guaranteed to start the crusher loaded full of limestone, tamped down solid . . . and it does it.

ELLIOTT COMPANY
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Electric Power Department
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District Offices in Principal Cities

L-675

from 98.3% to 98.9% when used for reducing speed and from 97.5% to 98% when used for increasing speed. It will be noted that the efficiency is slightly less when used for increasing speed than when used for decreasing speed. This is due to the different tooth contact conditions when the larger gear is used to drive the smaller gear compared with the smaller gear driving the larger gear. This phenomenon of gear tooth action is not generally understood but in the design of speed reducers for relatively high speeds and high powers it is a factor which should be taken into consideration.

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Heat Treatment of Steels

Roessler & Hasslacher Chemical Company, New York, N. Y., is distributing an 80 page booklet containing a treatise on the Heat Treatment of Steels. Information given here on case-hardening and heat treating of steels is of a general nature. Copies may be obtained by writing the above concern.

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World's Largest Transformer for Hell Gate

Transformer capacity for a single unit reached a new maximum when the Westinghouse Electric and Manufacturing Company recently shipped from its Sharon Works a 70,000 kv-a. transformer to New York for the Hell Gate Station of the United Electric Light and Power Company. It is the world's largest self-cooled two-winding rating ever built.

Weighing 220 tons, the unit is 28 feet high and requires 750 square feet of floor space. Ten railroad cars were needed for its shipment, five of these containing oil for insulating and cooling purposes.

▲

New Electric Space Heater

Bulletin 15510 announced by Cutler-Hammer, Inc., 259 North Twelfth Street, Milwaukee, Wisconsin, covers a new electric space heater.

This space heater is of an entirely new design. Its heating element is Nickel Chromium Alloy. A highly refractory granular compound is used for insulation. No cement or spacers are used. A new process of imbedding the element in this compound under immense pressure makes the new space heater immune to vibration and jarring, it is claimed.

A descriptive pamphlet on this new space heater will be sent upon request, by the manufacturer.

▲

C-E Multiple Circulation Boiler

Combustion Engineering Corporation, 200 Madison Avenue, New York, has just issued a pamphlet describing the C-E Multiple Circulation Boiler. This boiler is designed to provide the positive and unrestricted circulation which is so important in modern boiler practice with its high steam pressures, high temperatures and high rates of evaporation. The pamphlet contains table of specifications covering the four types in which this boiler is manufactured. Copies of this pamphlet may be secured by writing the above company.

▲

All-Welded Locomotive

Seven all-welded locomotives have been constructed by the General Electric Company for switching service at Bush Terminal, New York City. While the engines and electric equipment follow the usual standards of design, many new features are incorporated in the framework because of the use of welding.

The complete structure of cab, under-frame and trucks is fabricated entirely from structural steel shapes and plates, and is arc welded throughout. There are no rivets, and bolts have been used only for those portions requiring occasional removal or renewal.

▲

OBITUARY

Samuel Mather, senior member of the firm Pickands, Mather & Company, Cleveland, Ohio died at his home in Cleveland on October 18, 1931. Mr. Mather was one of the best known men in the Iron and Steel Industry. He was a member of the American Institute of Mining & Metallurgical Engineers and has for many years been a guiding hand in the American Iron & Steel Institute.

ORDERS FOR ELECTRICAL GOODS

Third Quarter, 1931
Compared With Preceding Quarters

New orders booked during the third quarter of 1931, as reported to the Bureau of the Census by 84 manufacturers of electrical goods, were $157,471,784, as compared with $224,347,794, for the second quarter of 1931, and $228,732,926 for the third quarter of 1930. The following totals of bookings for each quarter since the beginning of 1925 include motors, storage batteries, domestic appliances, and industrial equipment, and are presented, not as a complete statement of the industry, but probably as sufficiently representative to indicate the trend:

Year	Total	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1925	$ 922,678,576	$229,834,348	$224,660,091	$227,750,093	$240,434,044
1926	1,001,340,484	260,630,783	245,729,343	238,900,568	256,079,790
1927	944,777,664	240,257,620	234,126,886	233,600,772	236,792,386
1928	1,054,957,490	243,071,142	251,993,086	271,604,090	288,289,172
1929	1,363,610,043	340,483,965	359,090,125	357,188,354	306,847,599
1930	1,044,899,812	314,329,372	292,902,071	228,732,926	208,935,443
1931		182,485,841	*224,347,794	157,471,784	

5-year (1926-1930) quarterly average—$270,479,275

*Revised.

TECHNOLOGY DEPT.

First Copy

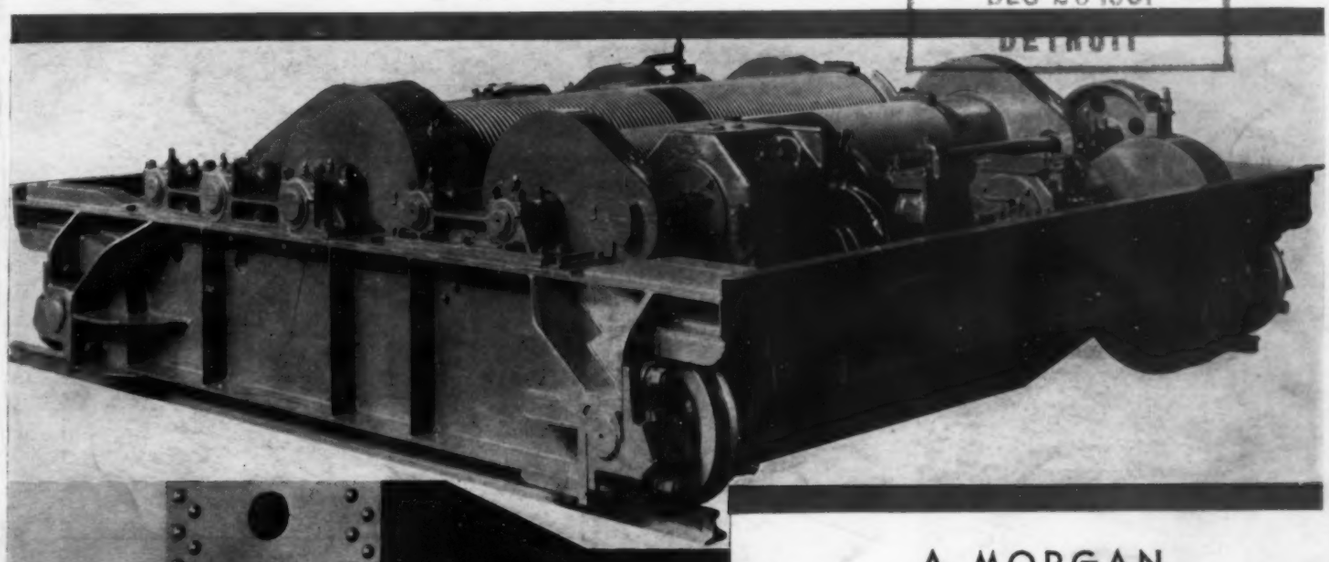
IRON and STEEL ENGINEER

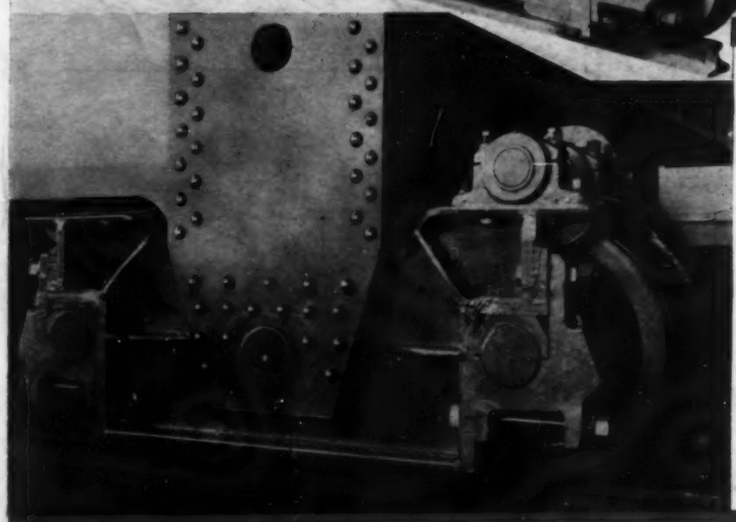
FUEL · ELECTRICITY · ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907 · MACHINERY · METHODS

EMPIRE BUILDING, Pittsburgh, Pa.

DECEMBER, 1931

PUBLIC [illegible]
DEC 23 1931
DETROIT





A MORGAN
100-TON WELDED CRANE

The trolley frame and bridge end trucks are built up of rolled steel shapes and each welded into a one-piece unit.

The span of the trolley is 12′-6″ and wheelbase 11′-9″.

The wheelbase of the bridge truck is 5′-0″.

THE MORGAN ENGINEERING COMPANY

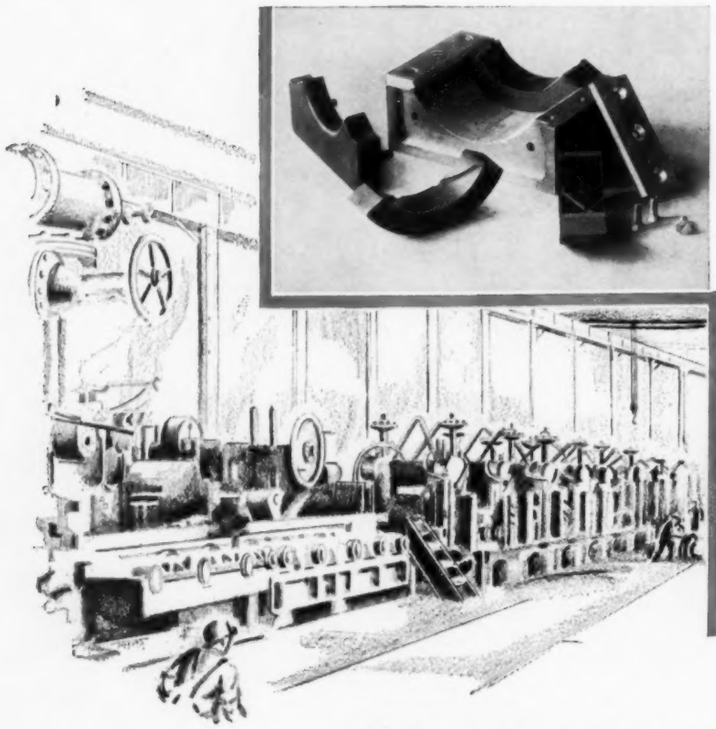
NEW YORK: 25 Broadway — ALLIANCE, OHIO, U. S. A. — PITTSBURGH: 1420 Oliver Bldg.

MORGAN DESIGNS AND BUILDS

Blooming Mills, Plate Mills, Structural Mills, Continuous Mills, Rod and Bar Mills, Electric Traveling Cranes, Steam Hydraulic Forging Presses, Steam Hammers.

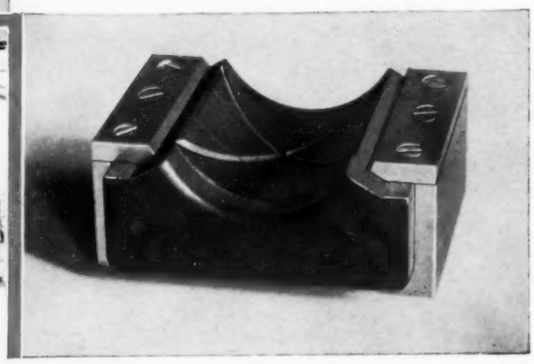
DESIGNERS · MANUFACTURERS · CONTRACTORS

LONGER LIFE
for Roll Neck Bearings



Exploded view of roll neck bearing showing MICARTA lining. In most cases it can be installed by modifying your present chucks.

A new MICARTA lining assembled in a chuck.



SHORT life bearings pile up maintenance expense, but what is more important, every bearing failure necessitates a shut-down, halts production, and multiplies many times the losses due to the worn-out bearing. To reduce such losses, to obtain longer life from roll neck bearings, install Micarta linings in your chucks.

Micarta lining, a long-wearing laminated material, possesses many advantages over metal. Seizing and grabbing are eliminated. Instead of scoring the shaft, Micarta gives it a polish. Micarta withstands shocks and blows that damage and fatigue ordinary lining. Power savings as high as 30% may be expected. Water alone is used as a lubricant; acids and alkalis in impure water have no effect on Micarta. All these advantages give roll neck bearings with Micarta lining a life 4 to 10 times longer than that of ordinary bearings.

At present, Micarta roll neck bearings are being used successfully on wire, rod, bar, and merchant mills. Bearings for larger mills are under experiment. A Micarta Specialist in our district office near you will tell you more about how Micarta lining cuts roll neck bearing costs.

Service, prompt and efficient, by a coast-to-coast chain of well-equipped shops

Westinghouse

WESTINGHOUSE ELECTRIC

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